Light and Lighting

XXIX.—No. 3. March, 1936 Price 9

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Incorporating "The Illuminating Engineer."

Light and Lighting

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Principal Contents:

Are "Breaking Tests" Necessary?

AN old problem for engineers is the devising of tests such as will ensure quality without being too destructive.

The engineer as a rule cannot test the finished object—he cannot, for instance, lay down that a certain percentage of cranes or bridges must endure an exacting test without coming to pieces! The best he can do is to ensure that the materials are up to standard.

How far should the same principle apply in illuminating engineering?

Incandescent electric lamps, admittedly, must be tested as *lamps*—we cannot ensure quality by testing the glass used in the bulbs or the material used for the filament.

But is a "breaking test" necessary for glassware? The informative discussion on Thermal Tests at the meeting of the Illuminating Engineering Society on February 11th showed that the development of these tests has had good results.

But the tests are laborious and may be expensive. It has been suggested that the time is ripe for users to specify glass of requisite thermal endurance for their purpose, and, if necessary, to test samples of glass rather than fittings—evidently a simpler and less expensive process.

The designer of lighting fittings would then be in the same position as an engineer who determines the stresses in his structure and specifies steel that will stand them.

The I.E.S. Photometric Section—Comparing Coloured Light Sources—Showmanship in the Lecture Theatre — Photographs by Infra Red Rays—A new Euston Station — Advice to Architects—The Problem of Glare.

I.E.S. "Photometric Section" Launched

The first of the proposed special sections of the Illuminating Engineering Society—that dealing with Photometry—was duly launchd on February 4 when about fifty members assembled at the Westminster Technical Institute to hear Dr. Walsh's introductory address. This was an excellent attendance for a somewhat specialised meeting, and as over sixty members have asked to be notified of forthcoming events there should be no doubt about the success of the section. We understand that another meeting will be held in April. Those interested in the section who have not yet sent in their names should communicate with Mr. K. F. Sawyer (Watson House, Nine Elms-lane, London, S.W.8), who is acting as secretary. We are told that plenty of topics for coming meetings have been suggested. But the benefit should not stop here. We hope that another result of the formation of the section will be that members interested in photometry will get to know each other, visit each others' laboratories, and generally exchange experiences.

Comparing Coloured Light Sources

Dr. Walsh, in his address (with which we deal on pages 76-78), wisely did not attempt to survey the whole field of photometry but contented himself with commenting on a few chief problems of the day. Of these undoubtedly one of the most formidable is the comparison of sources of light which differ considerably in colour. This is a topic on which photometric experts loved to argue even twenty-five years ago, when the Illuminating Engineering Society had only just been started. At that time neither they nor others took the matter too seriously—for the differences in colour of the arc lamps, electric filament lamps and incandescent mantles of that day, all of which yield continuous spectra, are not severe. But now, with electric discharge lamps yielding line spectra of the most varied character, there is something to argue about—especially in view of the very low illuminations prevalent in the streets by night. There are just two considerations that may ultimately make things easier in the future, *firstly* that the level of illumination in the streets may be raised considerably in years to come, *secondly* that a closer approach to white light even in dischqarge lamps may become general, so that their difference, from a photometric standpoint, may be lessened.

Homes of the Stars

At the Ideal Homes Exhibition, to open at Olympia on March 24, about 60,000 square feet are to be devoted to rooms from the homes of leading British and American film stars. Each room will reflect the personality of the star and something unusual in the way of lighting may be expected. The same, no doubt, will apply to "The Shape of Things to Come," which is based on the scenes in H. G. Wells's film.

Forthcoming Events.

March 10th.—Visit of Members of the Illuminating Engineering Society to the **National Physical Laboratory,** Teddington. After an address by Dr. J. W. T. Walsh the Photometric Department will be visited. *Members assemble in the Laboratory Canteen;* **5·30—6.30 p.m.**

March 17th.—Mr. A. G. Brown and Mr. A. L. Whittenham on **"The World's Most Modern Fish Dock"** *(Meeting of the North-Western Area Local Section Centre of the Illuminating Engineering Society, at the Engineer's Club, Albert Square, Manchester);* **7.30 p.m.**

March 24th.—Annual Dinner and **Dance** of the Illuminating Engineering Society *(at the Trocadero Restaurant, Piccadilly, London, W.);* **7** for **7.30 p.m.**

March 31st.—Informal Meeting of the Illuminating Engineering Society *(at St. Ermin's Hotel, Caxton Street, Westminster, S.W.1);* **6.30 p.m.**

A correspondent sends us a cutting of the advertisement reproduced below. We can readily believe that the lighting area requiring attention is not a very vast one; but even so there seems hardly need for the caution in the final paragraph that this is a full time job! The advertisement surely sheds light (where it is probably needed) on conditions in rural areas. A good case for the treatment of the "King's Highway" on a national basis has certainly been made out.

Pity The Poor Public Lighting Engineer!

GARFORTH Urban Council, Yorkshire, have decided to invite applications from men who will have to carry out the duties of pumping attendant at the sewage works, lighting attendant, ambulance driver, boiler and mortuary attendant, and also carry out general odd jobs.

Not only must the applicant be able to drive a car, but he must be qualified in electrical work.

The job is a full-time one—and the wage £3 a week.

Showmanship in the Lecture Theatre

The value of skill in the presentation of a subject and of the most perfect equipment for displaying demonstrations was strikingly exemplified at the Royal Institution on January 31, when Dr. C. E. K. Mees delivered his discourse on "Sensitising Dyes and Their Application to Scientific Photography." The address, which reviewed a series of brilliant researches, was enhanced by the "slick" way in which Dr. Mees produced specimens of series of dyes simultaneously with the appearance of their formulae on the screen. The range of colours was agreeably illustrated by pouring the contents of test tubes into flasks of clear water illuminated from below by concealed lamps. Equally instructive were the arrangements for local lighting. Besides the general lighting of the room the lecturer had the choice of three methods, any one of which could be applied without interfering with the display of lantern slides—comparatively diffused lighting from the recess in the ceiling above the lecture table, a concentrated vertical beam picking out individual bits of apparatus thereon, and a spot-light directed from the vicinity of the lantern, which could be used either to illuminate apparatus or to direct attention to wall diagrams.

Photographs by Infra-Red Rays

Perhaps the most interesting part of the address was the section dealing with remarkable recent progress in the preparation of plates sensitive in the far infra-red regions of the spectrum. It is now quite a number of years since Professor R. W. Wood, of Columbia University, excited interest by his display of distant landscapes taken by such rays—and still longer since Sir William Abney carried out his celebrated experiment of taking a photograph of a kettle on the boil. Dr. Mees, however, had a remarkable record of subsequent progress to report. By the aid of plates with a sensitiveness extending still further into the infra-red, photographs have been obtained showing clear views of mountain summits 330 miles away! It was also revealed that quite a respectable photograph of a bust could be taken by the aid of the heat radiation from a couple of adjacent flat-irons! Photographs of quite large audiences, seated in complete darkness, have likewise been taken by means of invisible infra-red rays. Very curious is the strange light texture of the foliage of trees in these infra-red photographs. Dr. Mees quoted an interesting theory to explain this effect, namely, that such foliage becomes luminous owing to the excitation of fluorescence by the infra-red rays. This, it is true, seems to be a departure from Stokes's law, in that the effect of excitation appears in a wavelength lower than the stimulus—an unusual, but possibly not an impossible condition.

A New Euston Station

According to the "Observer," some interesting new schemes are being considered by the railways. Chief amongst these is the rebuilding of Euston Station, which, in its new form, should give the London, Midland and Scottish Railway a real chance of showing their ideas of what up-to-date railway station lighting may be; and by this we mean the use of light to give information and reveal the existence of the station by night, as well as illuminating concours, platforms, waiting rooms, etc. The remodelling of Fenchurch-street, also in prospect, should offer another opportunity of bringing light into places which are—to put it mildly—hardly brightly illuminated. As regards provincial areas, it is stated that the station hotels at Hull and Leeds are to be rebuilt, and that Temple Meads Station, Bristol, is to undergo a reconstruction, which involves the provision of fifteen platforms instead of nine, at a cost of £1,000,000. All these schemes should afford opportunities of modernising the lighting. The L.N.E.R. is experimenting with colour schemes suited to individual stations; during the present year 354 stations are to be repainted in brighter colours—and in some cases, perhaps, brightened also by better lighting.

The "Kugelhaus," Dresden, an odd-shaped building that is prominent in the illuminated gardens by night.

Advice to Architects

In his address on "The Effectiveness of Electric Lighting" at the Conference for Architects, which opened at the E.L.M.A. Lighting Service Bureau on January 29, Mr. W. J. Jones again developed his ideas on "The Science of Seeing," to which reference was made in these columns quite recently (Jan., 1936, pp. 21-22). Mr. Jones made things easier for the consumer by recommending local lighting as a supplement to general lighting where unusually high values are desired, for example: (1) *in offices*, to give extra light where needed; (2) *in shops*, to give emphasis to displays and afford more light on counters; and (3) as a means of dramatic appeal. The Turin Exhibition, with concentrated light on each group of exhibits, was mentioned as an illustration of (3). The newly introduced "Study Lamp" is really an instance of judicious local lighting, though it is designed also to give sufficient general illumination to prevent undue contrasts.

Does it Pay to Use Large Lamps?

Does it pay to use large lamps? Not always, but there are cases where it is economical to avoid the smallest sizes. For example, the use of 60-watt lamps in a cornice in place of 25-watt lamps will give 50 per cent. more light with a saving of over 50 per cent. on lamp costs and equipment. Reasonable dimensions for cornices to house the larger lamps and equipment must, however, be provided. It is also worth noting that the 40-watt "coiled coil" lamp gives 20 per cent. more light than the single-coil lamp of similar wattage, whilst in the 60, 75, and 100-watt sizes the estimated advantage is respectively 15, 12½, and 10 per cent.

In conclusion, Mr. Jones quoted figures to illustrate the great advantages of the new electric discharge lamps as means of producing coloured light; their efficiency may be 2-4½ times as great as that of a screened incandescent lamp of similar colour value. The new light-sources should enable architects to experiment with colour on an unprecedented scale and with their use in combination with the general lighting of interiors.

Headlights on Locomotives

A departure in railway practice was made last month when the first train to carry powerful headlights ran from Pilmoor (Yorks) to Harrogate. It ran over a branch line controlled by a new system of chequer boards instead of semaphores and coloured light signals—all of which could be easily seen by the powerful beam.

I.E.S. DINNER: MARCH 24th

Don't forget the Annual Dinner of the Illuminating Engineering Society—at the Trocadero Restaurant, Piccadilly, March 24th—"The Jolliest Dinner in London."

The Problem of Glare

Our attention has been drawn to a contribution by Mr. D. G. Sandeman, of the Edinburgh Public Lighting Department, to the discussion of this pressing problem (Elec. Rev., Jan. 10, p. 52). The author produces a mathematical expression for the estimation of glare, and derives a form of polar curve for producing what he terms "standardised visibility," but might perhaps be better described as "uniform severity of the glare effect." We have our doubts whether glare in the streets can be thus estimated precisely by a mathematical formula; but, apart from this, can an evil be regarded as materially diminished merely because it is invariable? Mr. Sandeman also remarked that "Nature has perfectly compensated for the fall in illumination as we recede from a lamp by altering the reflecting properties of the road surface." We confess that we do not see here the hand of Nature (who would surely have been kinder to the public lighting engineer than to select black tar), but rather the result of the combined actions of the road engineer, in preparing the surface, and the motorist in bringing it to a high state of polish.

FLOODLIGHTING OF JAHORE BAURU MOSQUE, SINGAPORE.

We are indebted to the General Electric Co., Ltd., for the above picture of an eastern temple in Singapore, which was recently floodlighted by 12 projectors equipped with Osram lamps—an example of the application of modern Lighting to the "Unchanging East."

The Parkinson Horizontal Illumination Chart

In response to inquiries about the Parkinson Lighting Horizontal Illumination Chart, illustrated in our last number (pp. 46-47), we may mention that this diagram and the accompanying explanatory text has now been reprinted on stiff cardboard, so as to be conveniently used for practical calculations.

Copies of the chart thus reprinted will be furnished to any readers interested at a nominal price of 2s. 6d. post free.

Light Surroundings

An Important Contribution to the Solution of the Street Lighting Problem.

REALLY satisfactory visibility in the streets will never be attained until the mode of lighting is radically altered—i.e., until we are able to obtain conditions resembling daylight, at least as regards diffusion, if not intensity.

The present method, which consists in putting up lighting units on posts at considerable intervals, can never effectively illuminate an object from all directions, so that its dimensions and shape cannot be completely judged. Moreover, the illumination of such objects is necessarily so weak and the contrast with a dark background so poor that they can only be distinguished with difficulty. We are therefore driven to fall back on the secondary method of achieving visibility by revealing *outlines*, by causing figures of persons in the road to appear silhouetted against a bright road surface—and this is usually done imperfectly because it is difficult to render the road surface evenly bright all over. Furthermore, for brightness we rely to a great extent on images of distance light-sources formed on the shiny road surface. Hence the danger of "pools of darkness" which become accentuated in wet weather when the road surface becomes still more mirror-like.

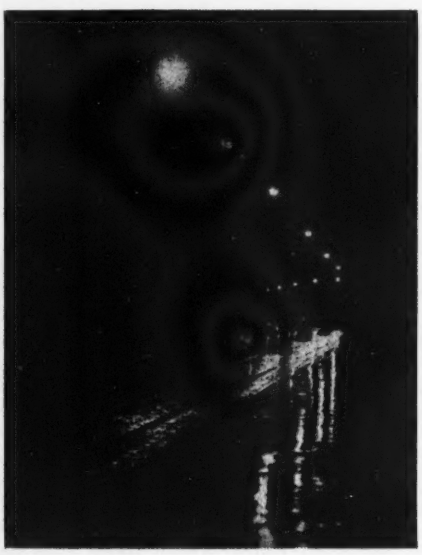
Illuminating engineers have often lamented the inconveniences of very dark and highly polished nature of road dressing materials. The hope that a "white tar" might ultimately be developed has been expressed!

But until this time arrives we have to do our best with the existing materials, and should therefore explore every possibility of making use of their reflecting value. The chief thing to be noted, if we frankly accept the idea that the silhouette effect is the thing to build our hopes on, is that we do not really want concentrated brightness in our sources of light. It is much more important that their brightness should be spread over a large area so that their reflections in the road surface may likewise be extensive and the "pools of darkness reduced to a minimum.

In cities this condition is in some degree provided by reflected light from adjacent buildings, etc. Floodlighted surfaces, and even luminous signs, if of moderate brightness, may play a useful rôle, partly because their reflections in the road surface are valuable, and also because their presence lessens the contrast with the light sources, which are apt to appear glaring if seen against a background of unrelieved gloom.

It has also been remarked, by Mr. F. C. Smith and others, that whilst the road surface is doubtless the *chief* background that affects the visibility of objects upon it, there are often cases when a light background at the side of the road is of great importance. This applies, for example, to sharp corners where a whitened fence or hoarding may make all the difference to the ease with which things can be seen. Moreover, the reflections of such surfaces, if they are strongly lighted, may be of considerable help when the road surfaces are wet and shiny.

A rather striking confirmation of this view has recently been given by E. von der Trappen in "Das Licht." The two photographs, here reproduced, show the effect of a very simple device adopted by the electric supply undertaking (Bewag) in Berlin. This device consists merely in suspending above the street a strip of metal approximately 2 ft. deep and 12 ft. wide, which was painted white and illuminated by four screened 150-watt electric lamps mounted along the upper edge The idea is, doubtless, most readily applicable to long, straight lengths of roadway, but it is pointed out that it may also prove useful in other cases where the illumination is hardly adequate and especially so when, owing to the arrangement of the street lamps, drivers unfamiliar with the locality are apt to be misled into thinking that a road continues to go forward when, actually, it takes a sharp turn.



(*a*) Without Illuminated Strip.

These two pictures were presented by E. von der Trappen in *Das Licht* (Nov. 10, 1935, p. 246).

On the left is shown the ordinary street lighting.

On the right the valuable effect of the distant strip of illuminated white material in improving the appearance of the wet road surface is strikingly evident.

(*b*) With Illuminated Strip.

Such methods have the further advantage that they alleviate the "tunnel effect," i.e., the troublesome impression created by the contrast between street lamps, which are isolated points of bright light, and the surrounding obscurity. Street lamps almost inevitably have some degree of glare owing to the effort to increase the illumination at distant points, which can only be done by increasing the candle-power at angles slightly below the horizontal.

Undoubtedly, any glare that exists is magnified if the lamps are seen against a background of darkness, for the eye is more or less dark-adapted, and therefore highly sensitive to glare.

OUTSTANDING PROBLEMS IN PHOTOMETRY

by

John W. T. Walsh, M.A., D.Sc., M.I.E.E.

This Address was delivered at the Opening Meeting of the new "Photometric Section" of the Illuminating Engineering Society, which took place at the Westminster Technical Institute on February 4th. The meeting was attended by about 50 members and friends and served as an excellent "send-off" for the Section.

The most convenient way of discovering our problems is, probably, to consider the types of measurement which we are most frequently called upon to perform. These are measurements of candle-power, flux, illumination, and brightness.

For any measurement we need (a) a standard and (b) an instrument. As a fundamental photometric standard we can choose either of the four quantities mentioned above, since all are related. Actually, however, they fall into two pairs, since there is a very close relationship between c.p. and brightness and between flux and illumination.

A "Black Body" Standard of Light.

Hitherto attention has mainly been directed to the first pair, viz., c.p. and brightness. For instance, the flame standards (Pentane and Hefner) were c.p. standards. Our present working sub-standards are all c.p. standards. We have at present no standard reproducible from specification. The current proposal is for a brightness standard, viz., the brightness of a black body maintained at the temperature of solidification of platinum. The form being studied at the present time is shown in Fig. 1. The black body is the small thoria tube immersed in platinum in a thoria crucible, the platinum being heated by means of a high-frequency induction furnace. Fig. 2 shows the values of brightness recorded during a typical melt and freeze of the platinum.

The outstanding problems in the development of this standard are all connected with the attainment of the highest precision in the final value, notably (a) very fine temperature control, (b) accurate determination of the transmission factor of the lens-prism combination, (c) accurate measurement of the distances involved.

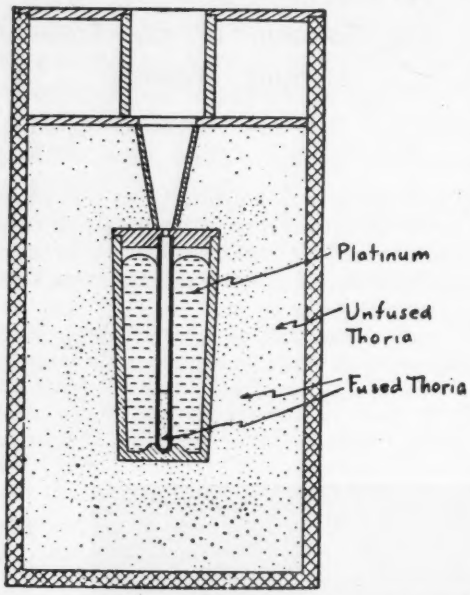


Fig. 1. Essential parts of proposed Primary Standard of Light.

? An Energy Standard.

The proposal has been made at various times to avoid altogether the use of a separate standard for photometry and to use an energy standard, combined with an agreed set of values for the factor relating energy with luminous effect at different wavelengths (the so-called visibility or luminosity factor). The most convenient form of this standard would be one of energy density on an irradiated surface, converted to illumination.

The outstanding problem here is again one of accurate measurement. The energy received per unit area on any given surface cannot at present be measured to a precision better than about one per cent. The value of the luminosity factor or factors may be agreed quite arbitrarily and the present international values are probably quite satisfactory.

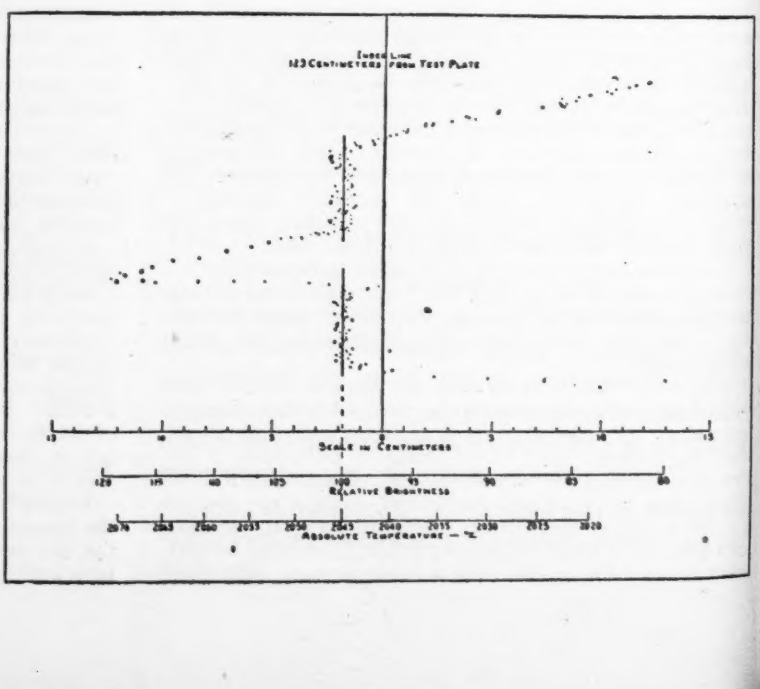


Fig. 2. Values of brightness recorded during a typical melt and freeze of the platinum in the proposed "black body" standard of light.

Flux or Candle-power.

Apart from the practical advantages possessed by one or other of the actual standards described above, there is the more general matter of the relative advantages of c.p. (or brightness) and flux (or illumination) as a primary standard.

These advantages are mainly linked up with the necessity for transferring from the primary standard to working sub-standards, and with the accuracy attainable when using these sub-standards for every-day measurements. If the primary standard is one of c.p. or brightness, the sub-standards will probably be c.p. standards.

Since the photometer head compares illuminations and since no material source can be a true point source, it follows that an uncertainty is introduced into every comparison of candle-powers. In fact, no material source has, in the strictest sense, a unique candle-power value

Fig. 3 shows how the apparent c.p. of a disc or a line source varies with the ratio of the distance at which the measurement is made (d) to the length of the line (L) or the diameter of the disc (D).

To get over this difficulty, as is sometimes done, by specifying the distance of the source from the photometer, is, in essence, to reduce the standard to one of illumination.

This objection to c.p. standards can, however, be rendered purely academic by specifying that the distance of the standard from the photometer must not fall outside certain limits so chosen that the error committed in such circumstances can never exceed, say, 0.05 per cent.

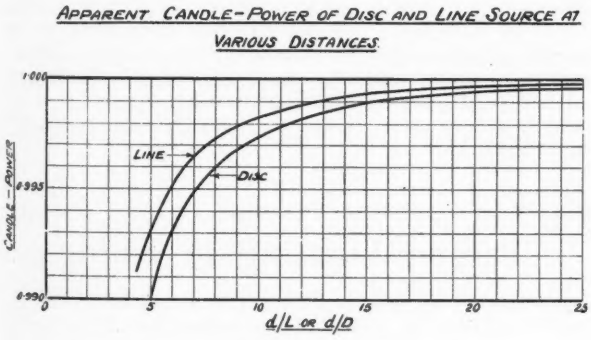


Fig. 3.

Conditions for a Sub-Standard.

This means that with the ordinary form of sub-standard, in which the source is an incandescent filament in the form of a grid (see Fig. 4), the distance of the photometer head from the lamp must exceed fifteen to twenty times the maximum linear dimension of the grid.

Since an illumination of at least ten metre-candles is required at the photometer head for accurate visual measurement, it follows that the numerical c.p. of the lamps must be at least one-third of the area covered by the grid in sq. cm. This condition is fairly easy to fulfil, but it necessitates the use of a rather thick filament in the case of a lamp running at the same colour temperature as the black-body standard referred to above. It is less easy to ensure that the source of light is really in one plane. Accurate alignment of the filaments is difficult to secure, and a still more fruitful source of trouble is the production of images of the filament by the curved glass walls of the bulb. A special form of lamp bulb has been designed with the object of overcoming this difficulty (see Fig. 5).

Other problems of construction arise in designing a lamp to give the extreme steadiness and constancy necessary for a sub-standard.

Let us now assume that all the problems mentioned above have been satisfactorily overcome and

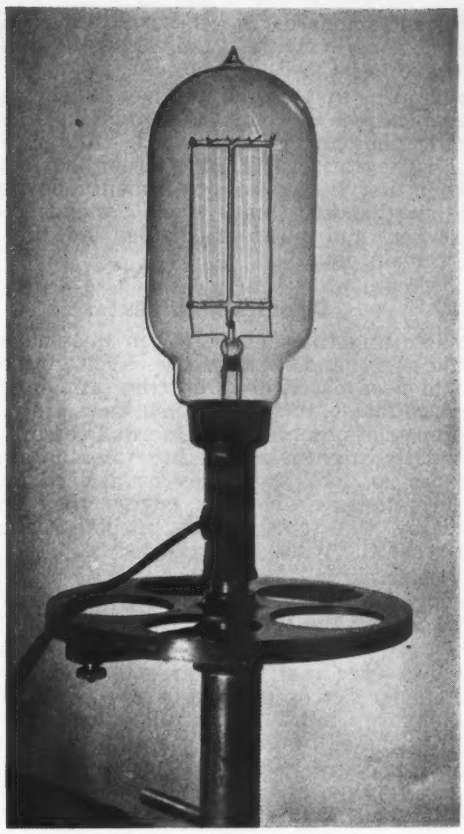


Fig. 4. Sub-standard with Incandescent Filament in the form of a grid.

that we have a set of sub-standards whose c.p. values are known to, say, 0.1 per cent.

These sub-standards match in colour the primary standard, but the sources of light in every-day use do not. The measurement of such sources, therefore, involves all the problems of heterochromatic photometry.

Even if the primary standard were based on an energy measurement, the difficulty would not be removed because it would still be necessary to have

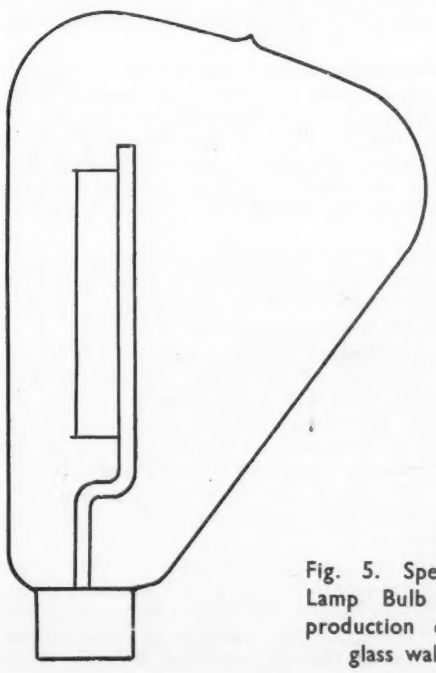


Fig. 5. Special Form of Lamp Bulb to eliminate production of images by glass walls of bulb.

lamps as sub-standards, and these, clearly, could not give a colour-match with all the various light sources which have to be measured.

It so happens that the recent advent of the gaseous discharge lamps has brought the problems of heterochromatic photometry very much into the foreground. They arise principally from the fact that the eye is not a physical instrument obeying the simple law that two things which are judged to be equal, when multiplied or divided by the same factor, remain equal.

Colour Difficulties.

The field-brightness effect (often known as the Purkinje effect) and the field-size effect are too well known to need description, but the problem which we have to face is this: If two surfaces are judged, by a number of observers with normal colour-vision, to be equally bright when the brightness is, say, one candle per sq. foot, shall they be *defined* to have equal brightnesses when the energy they emit is reduced by the same factor in both cases, no matter what the value of the factor is?

They certainly will not appear equally bright, and if we adopt what appears to be the only possible convention, we run the risk of being told by the "man in the street" that we are talking nonsense.

This is a very real problem which demands an immediate decision on the part of all those interested in photometry, and I respectfully suggest that it should be debated by this section at an early date.

It may, of course, be urged that the subject has been closed by the international adoption of a curve of luminosity factors determined under "high brightness" conditions with a small field size, and that the only remaining problem is to devise methods of measurement which will give results in accord with this convention. This may be true as far as measurements of the light output from sources is concerned. It is less certain that some other convention may not be necessary when low levels of illumination are in question, as in street lighting.

Now let it be assumed that not only the problems connected with the establishment of a satisfactory primary standard, but also those involved in the preparation of sub-standards suitable for measuring every-day sources of light have been satisfactorily solved. There still remain problems connected with the accurate comparison of two sources of identical type. These are largely bound up with the necessity for using photo-electric cells, either on account of their high sensitivity or else because of their convenience.

To take an example, when the c.p. of a lamp is being compared on the bench, it is necessary to measure the distance from the light centre of the lamp to some definable plane in the photocell. It is therefore a common practice to use a diffusing surface close to the cell and to measure to this surface. This device reduces the trouble but does not remove it entirely.

Difficulties due to the non-linear response of cells and to their colour sensitivity curves have been the subject of a great deal of study within the past few years, but further work remains to be done.

The design of illumination photometers still leaves much to be desired, as reference to the British Standard Specification will immediately reveal. In the lower ranges of illumination the accuracy of any visual instrument is limited by the sensitivity of the eye, so that the only prospect of considerable improvement at this end of the scale (and it is a very important region) lies in the adoption of some physical method.

Unfortunately the use of photocells for this work is attended with many difficulties. Changes of sensitivity due to temperature, effect of obliquity of the incident light, difficulty in correcting the colour sensitivity to that of the eye, are but a few. However, great advances have already been made, and it is therefore legitimate to hope for further progress in this field.

Photometry of Projection Apparatus.

Finally, I should like to refer to a special class of photometric measurement which presents problems of its own. I refer to the photometry of projection apparatus such as automobile headlights, signal lights and similar devices. For such apparatus the conception of c.p. often becomes meaningless, especially towards the edge of the beam. The different optical elements produce beams for which the effective light centres are at such widely separated positions that there is no point which can be regarded, even approximately, as the effective light centre of the whole.

There seem to be two possible methods of attack. One is to abandon c.p. measurements altogether and give a figure or figures for the illumination produced at a specified distance from the face of the projector. The other is to make measurements of c.p. at very great distances from the projector, e.g., half a mile in the case of a railway signal. This calls for the use of a telephotometer, and a sensitive instrument of this type may well become part of the regular equipment of any photometric laboratory dealing with projection apparatus.

Conclusion.

An attempt has been made above to sketch the problems which seem immediately to confront workers in photometry. I have deliberately confined myself to the problems which arise in the actual process of measurement. Many other problems arise in the application of the measurements or in deciding what type of measurement is most appropriate in any particular case. These, however, are rather problems of the illuminating engineer with which this section of the Society is not specially concerned.

Parade Lighting in Ealing

"Parade Lighting" with electric lamps has recently been installed by the Ealing Corporation Electricity Department under the supervision of Mr. R. Birt, the Borough Electrical Engineer, outside the premises

of Messrs. Jones and Knight, West Ealing. Four Holophane Hedralite wide-angle floodlights, 11 ft. from the building and 11 ft. 6 in. high, are mounted at the edge of the footpath. The flat prismatic plates enable a small percentage of transmitted light to illuminate the footpath and near-side roadway. The backs of the square boxes each containing a 750-watt lamp, are glazed with light satin-finished glass.

THE CLASSIFICATION OF SYMMETRICAL LIGHT DISTRIBUTIONS

In his paper on the above subject, read before the Illuminating Engineering Society on February 11, Mr. H. Buckley dealt with a somewhat intricate problem, but one of considerable interest to illuminating engineers. This question of classification of lighting fittings was raised at the Bellagio meeting of the International Commission on Illumination in 1927. It has since been the subject of controversy at subsequent I.C.I. meetings in 1928, 1931, and 1935, and it forms the subject of a British Standard Specification, first issued in 1930 and now undergoing revision.*

The question of flux distribution, as M. Wetzel has pointed out, has two main aspects, the type of lighting required from a fitting, and the degree of uniformity of illumination required, on which the recommended height-spacing ratio is largely based. The illuminating engineer, in planning a lighting installation, has two main problems to settle:—

(1) What proportion of the flux shall be directed on to the ceilings?

(2) What height-spacing ratios are best with the light-distributions available, or, alternatively, what light-distributions are most suitable for the convenient height-spacing ratios?

The final classification, which affects (1) has been settled without difficulty, and was, in fact, approved at the most recent international meeting, that in 1935. This is shown in Table I.

TABLE I.

Class.	Definition.
Direct	Not less than 90% of the total flux in the lower hemisphere.
Semi-direct	More than 60% and less than 90% of the total flux in the lower hemisphere.
General	Not less than 40% or more than 60% of the total flux in either hemisphere.
Semi-indirect	More than 60% and less than 90% of the total flux in the upper hemisphere.
Indirect	Not less than 90% of the total flux in the lower hemisphere.

But the second subsidiary classification corresponding to (2) has proved more difficult and agreement was less readily secured. The device which has proved most acceptable in this country was at first called the "box ratio" method, and later the "frame ratio" method consists in taking the polar curve of a light distribution in either the upper or lower hemisphere depending on which contains the major portion of the flux, and drawing a rectangle whose sides are parallel to the 0° radius vector and to the 90° radius vector of the polar curve so as to completely enclose the polar curve. This is shown in Fig. 1 for several distributions. The method proposed to describe the polar curve by the ratio of the sides of this circumscribing rectangle, viz., w/h, where w is the width of the rectangle and h is its height. The different types of distribution were then defined numerically by this ratio.

A classification in terms of frame ratio limits is evidently not very easy to attain, when one remembers the diversity of method in different countries, and the fact that descriptive terms ("focussing," "concentrating," "extensive," etc.) have been adopted by various manufacturers to describe certain types of fittings which they market. The classification shown in Table II. has, however, been proposed:—

TABLE II.

Class.	Term.	Frame Ratio Limits.	Zones of Max. C.P.
I.	Extra Narrow	0.00—0.18	0°— 5°
II.	Narrow	0.18—0.80	0°—24°
III.	Intermediate	0.80—1.40	0°—45°
IV.	Wide	1.40—3.00	0°—90°
V.	Extra Wide	3.00—	48°—90°

An important consideration is the bearing of the "frame ratio" on the spacing-height ratio, and the desirable degree of uniformity in practice.

The British sub-committee formed the opinion that it was unnecessary to strive for perfectly uniform

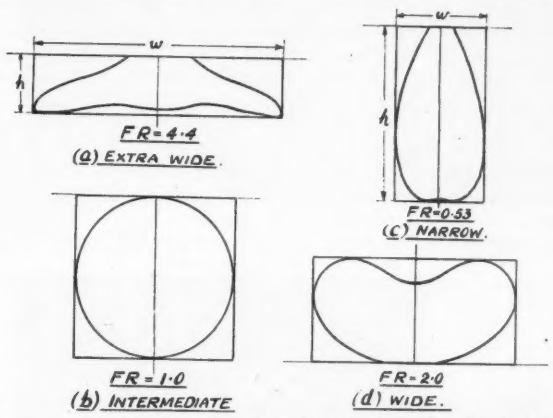


Fig. 1. Showing Typical Polar Curves of Light Distribution and method of obtaining the "Frame Ratio (w/h).

illumination, and that the higher the average illumination the less the uniformity ratio might be. It was finally decided that when the average illumination was 20 f.c. or over, a uniformity ratio of 50 per cent. was sufficient, but when the average illumination was lower, the uniformity ratio should be 70 per cent. This conclusion was based on examination of modern practice and the experience of members of the sub-committee.

Adopting these alternative degrees of uniformity the data are presented in Tables III. and IV.:

TABLE III.

For 75 per cent. Uniformity Ratio.

Frame Ratio			Spacing-Height Ratio.
Above	0.15—0.3	... ...	0.5
,,	0.3 —0.5	... ...	0.75
,,	0.5 —0.75	... ...	1.0
,,	0.75—1.0	... ...	1.25
,,	1.0 —1.33	... ...	1.5
,,	1.33—1.66	... ...	1.75
,,	1.66—2.1	... ...	2.00
,,	2.1 —2.5	... ...	2.25
,,	2.5 —3.0	... ...	2.50

TABLE IV.

For 50 per cent. Uniformity Ratio.

Frame Ratio.			Spacing-Height Ratio.
Above	0.15—0.25	... ...	0.5
,,	0.25—0.35	... ...	0.75
,,	0.35—0.5	... ...	1.0
,,	0.5 —0.7	... ...	1.25
,,	0.7 —0.9	... ...	1.5
,,	0.9 —1.2	... ...	1.75
,,	1.2 —1.5	... ...	2.0
,,	1.5 —1.8	... ...	2.25
,,	1.8 —2.2	... ...	2.5
,,	2.2 —2.7	... ...	2.75
,,	2.7 —3.2	... ...	3.0

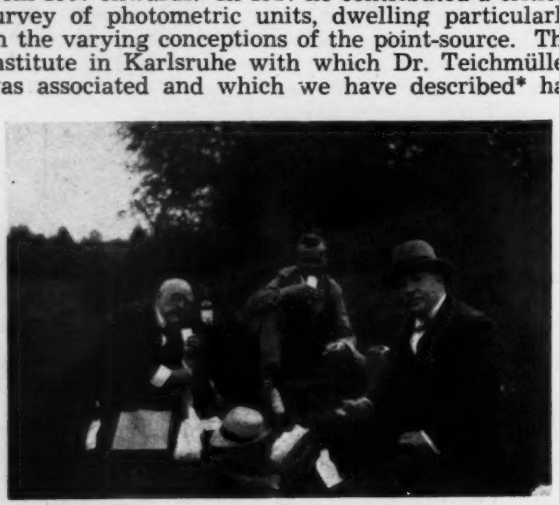
* British Standard Classification of Symmetrical Light Distributions from Lighting Fittings, No. 398, 1930.

In the course of his paper Mr. Buckley mentioned the curious fact that Mr. H. McWhirter, in a paper to be published by the Institution of Electrical Engineers, had independently and by a different method arrived at conclusions quite closely resembling those formed by the British Committee. The British proposals appear to have the great merit of simplicity. It is to be hoped that Mr. Buckley's paper, by making this work more widely known, will pave the way for exploration of these ideas and ultimately international agreement.

Professor J. Teichmüller

Germany is this month doing honour to Professor Dr. J. Teichmüller, of Karlsruhe, who, on March 4, reaches the 70th milestone of his life.

Dr. N. Halbertsma, who reminds us of this event, also sends the pleasing photograph reproduced below. German names have figured prominently in the history of photometry and illumination. Dr. Teichmüller's work has been exceptionally wide, including, as it does, contributions on such matters as glow-lamp specifications, arc-lamp adjustments, photometric units, and photometry and architectural lighting, from 1907 onwards. In 1917 he contributed a critical survey of photometric units, dwelling particularly on the varying conceptions of the point-source. The Institute in Karlsruhe with which Dr. Teichmüller was associated and which we have described* has



In this picture are seen Professor Teichmüller, Dr. Halbertsma, and the late Mr. L. Gaster, taking part in a picnic at Bellagio, where the 1917 I.C.I. meeting took place.

turned out many gifted illuminating engineers, who now occupy responsible positions. He undertook the organisation of the "Gesolei" Exhibition at Düsseldorf in 1926, and a section of the Barcelona Exhibition in 1928. In 1926 he coined the term "Lighting Architecture," and led the way towards what is now described as architectural lighting. Many will join us in wishing Dr. Teichmüller "many happy returns" and enjoyment of a long period of well-earned rest in retirement.

The High Pressure Mercury-Vapour Lamp in Public Lighting

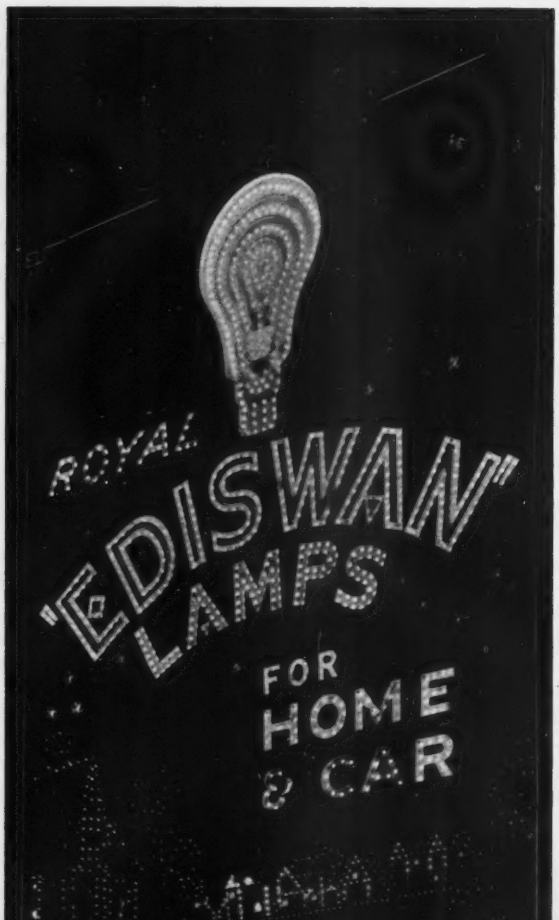
An informative paper on the above subject by Mr. G. H. Wilson, Mr. E. L. Damant, and Mr. J. M. Waldram was presented before the Institution of Electrical Engineers on February 27. The paper consisted of three main sections dealing with (a) the lamp and its auxiliaries; (b) the lanterns; and (c) the installation. In the final section the main principles of street lighting, the effect of road surface reflection, the conditions determining visibility, and the problem of glare were discussed. We hope to deal with the paper in a coming number.

* Illum. Eng., Feb., 1932, p. 45.

London's Largest Sign

The illustration below shows what is stated to be the largest animated sign in London (and in fact in Great Britain), which is now operating in Leicester Square. The sign is 47 ft. 6 in. in height and 30 ft. wide and has an area of 1,425 sq. ft. It was erected by Franco Signs for the Edison Swan Electric Co., Ltd., and is fitted with approximately 3,000 Royal Ediswan gasfilled lamps of various sizes and colours. The sign also uses more than 600 ft. of Franco-Neon Tubing.

Six motors, governed by a master controller which operates 25 electrically-controlled contactors, provide the motive power. The pressures applied



A striking animated sign in Leicester Square, London.

to the various sections of the sign range from 12 to 5,000 volts, and the total load is approximately 55 k.v.a. (equivalent to about 70 h.p.).

The cycle of operations lasts about a minute. It begins with the expansion of the lamp shape through four movements Flickering lamp-light rays then appear. Next timbers fall from the sky and build the house in the bottom left-hand corner, the garden gradually grows to full brilliance and the fountain plays. The road and houses in the background then appear and motor-cars begin to run along the road, stars twinkle, and the message "Royal Ediswan Lamps for Home and Car" appears to complete the picture.

THERMAL TESTS OF ILLUMINATING GLASSWARE

At a meeting of the Illuminating Engineering Society on February 11th, two papers dealing with Thermal Tests for Illuminating Glassware were presented. The first, by Mr. S. F. Dunkley, of the Gas Light and Coke Company, and Mr. W. R. Stevens of the G.E.C. Research Laboratories (Wembley), surveyed the problem in general terms; the second, by Mr. S. F. Dunkley, dealt in detail with the qualities to be demanded from heat-resisting glassware and tests for their control.

A problem of great importance was raised at the last meeting of the Illuminating Engineering Society when these two papers were read. Glass used in modern fittings, both for gas and electric lighting, has to meet conditions much more stringent than in the early days of illuminating engineering, and it is important to devise sure and simple methods of ensuring that the requisite quality is maintained.

In the introductory paper Mr. Dunkley and Mr. Stevens recalled the original bathing tests proposed in British Standard Specification No. 324 of 1927. In such tests there are two main variables, i.e. (1) alteration in the water-bath temperature, and (2) alteration in the time elapsing between turning off the heating source and immersion of the bowl. Experience led to some modification of the original conditions.

Standard Bathing Test.

The test, to be endured without fracture or other injury, that is now incorporated in the B.S.S. 324, 1934, reads as follows:—

After operation for one hour in normal working conditions, the light source shall be extinguished, and the whole fitting or the glassware alone (whichever shall be mutually agreed by the parties using this specification) shall be plunged, after a lapse of time of 45 seconds, into water at a temperature of 55° C., the immersion being completed within a further five seconds.

The authors presented records of mass production testing, and commented on an apparent "spread" of results in bowls nominally identical, which is regarded as representing unavoidable variation in manufacture.

Water Drop and Water Spray Tests.

It is interesting to note that at the G.E.C. Research Laboratories other subsidiary tests have been contrived. The first of these consists in allowing water drops of known size to fall on heated samples of the glass. A second method, for complete fittings, is an artificial rain test, water spray equivalent to a rainfall of 40 inches per hour (about four times the maximum natural rainfall ever recorded) being directed on to the unit when placed in the open air. It seems to be established that repeated bathing of bowls does tend to weaken them—a possible explanation being that minute cracks in the glassware are gradually enlarged by the rapid expansion and contraction during heating and bathing.

Mr. Dunkley, in his supplementary paper, analysed the main physical properties desirable in illuminating glassware, such as mechanical strength, durability, and thermal endurance, and presented numerous tables illustrating the composition of standard varieties of glass and its effect on physical properties.

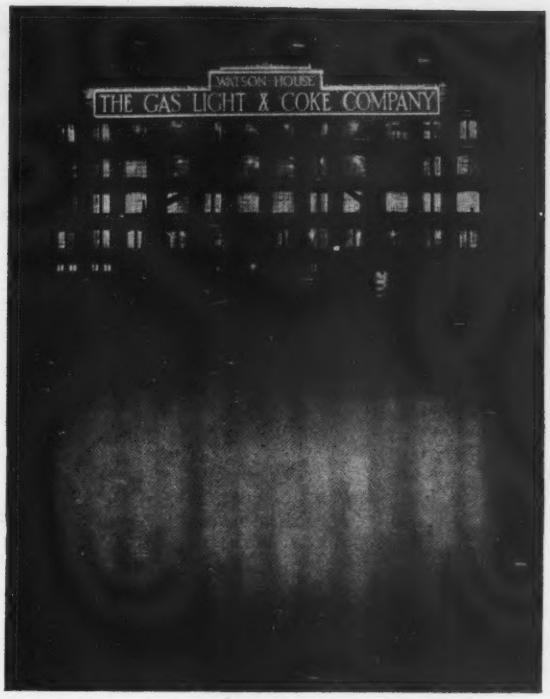


Fig. 1. A Photograph showing the exposed position of the sign on the river bank.

Breakages in Practice.

Breakages in practice may be due to a variety of causes, such as poor design, unsuitable composition, accidental manufacturing faults, and initial strain unrelieved. It is often difficult to distinguish between replacements due to poor thermal endurance, breakage due to handling, and failure due to poor durability. Under such difficult conditions as public lighting a figure of the order of half a globe per annum is, however, practicable. As an instance of what occurs with gas units under somewhat arduous conditions, the data presented in Fig. 1 relating to the familiar gas-lighted sign outside Watson House are instructive.

Advancing efficiency in illuminants has led to a continuous increase in temperature and a demand

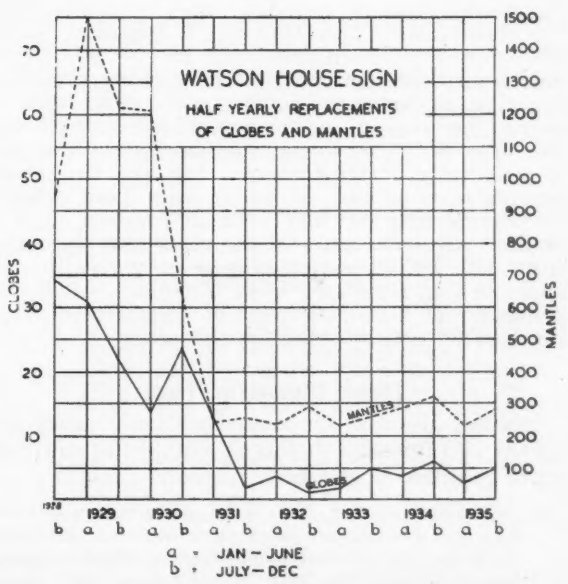


Fig. 2. Records of Replacements of Globes and Mantles for sign outside Watson House, visible from across the Thames.

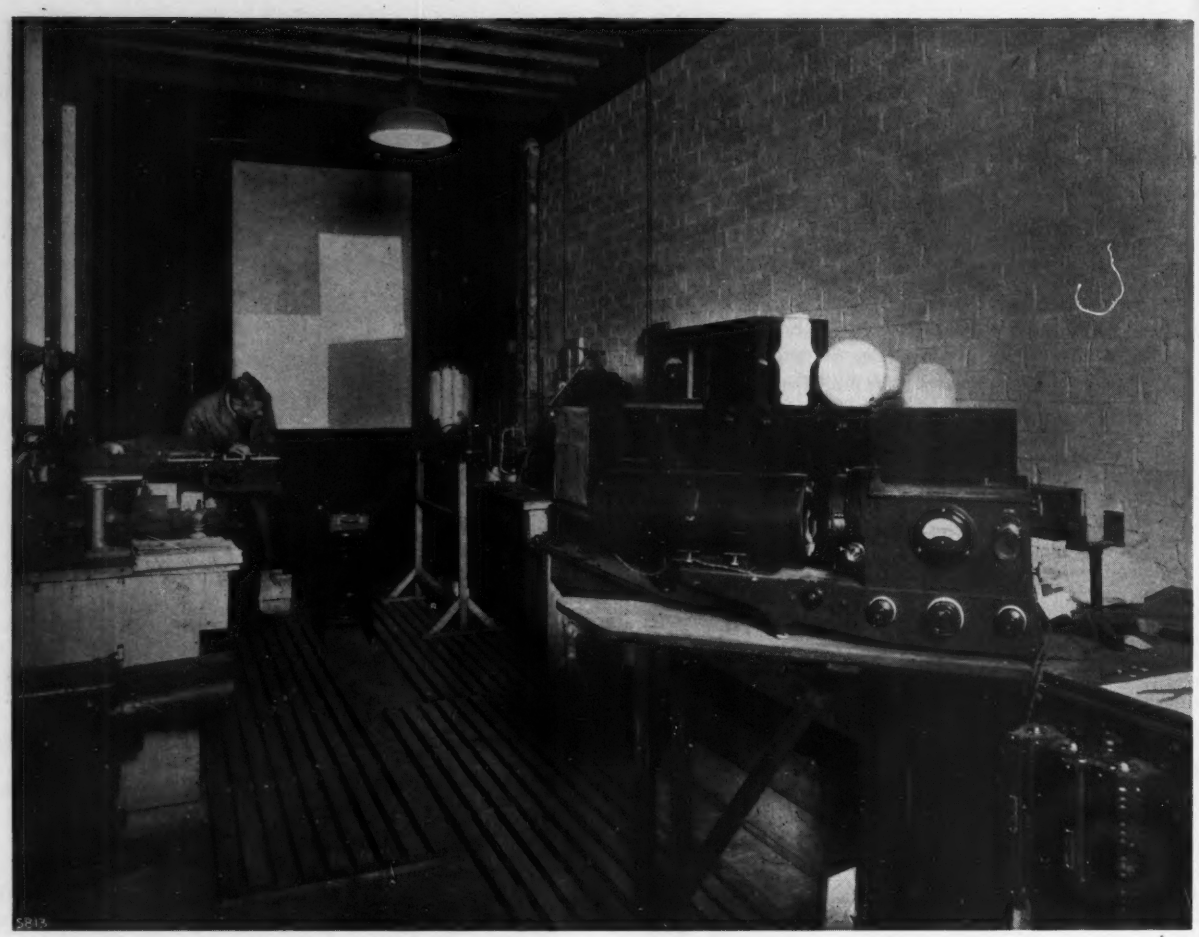


Fig. 3. A Portion of the Physics Laboratory at a Glass Works, showing Testing for Thermal Expansion.

for greater thermal endurance, to which the introduction of Standard Specifications has greatly contributed. Until comparatively recent years an outdoor lamp, under which the public had to pass, was invariably surrounded by a thin wire net, as a safeguard against possible accidents due to fracturing of the globe.

The only tests in which the user is interested so far as heat resisting glassware is concerned are those for wearability and (ii) thermal endurance. The former can be tested by the "powder test," "iodeosin test," "autoclave test." Thermal endurance tests have been developed by the B.S.I. committee already mentioned. Mr. Dunkley presented "cooling off" curves, showing how the rates of normal heating up and cooling off vary much with the type of globe under consideration. The test is essentially a stringent one, but not too severe, bearing in mind that in winter even more extreme conditions may be met with in practice. It is pointed out, however, that the conditions demanded from different types of glassware vary greatly. (In 1935 the Gas Light and Coke Company issued over a quarter of a million items of glassware of varying types, sizes, and conditions of use.)

Three Classes of Tests.

Bearing in mind this diversity, Mr. Dunkley suggested that the tests should be modified to suit three main qualities of glassware, namely:—

"A" QUALITY. — *For the most extreme conditions* i.e., for use on lamps of very high temperature, such as high-pressure gas lamps, electric lamps, multiple super-heater low-pressure gas lamps.

"B" QUALITY.—*For the less severe or normal* conditions of use, such as indoor electric units, low-pressure gas lamps and burners, and burner units.

"C" QUALITY.—*For the purely decorative illumination glassware* of the variety that has a large sale, but does not really fall under the category of heat resisting, but which, nevertheless, is satisfactory, providing care in use is exercised, and it is not exposed to sudden and severe draughts.

It is suggested that the tests to satisfy these applied to these three qualities should be modified in accordance with the following table:—

Quality.	Period of operation.	Lapse of time between extinction and immersion.	Temperature of water.
A	1 hour	30 sec.	10°C. (50°F.)
B	1 hour	45 sec.	55°C. (131°F.)
C	1 hour	90 sec.	100°C. (212°F.)

An Instructive Film.

An interesting feature at the meeting was the display of a film prepared by Mr. S. F. Dunkley and Mr. W. R. Stevens, illustrating the actual application of the tests and showing how, in individual cases, bowls either survived or cracked under the strain. The subsidiary "water-drop" and "artificial rain" tests were also shown in operation. In the course of the evening Mr. Stevens and his assistant carried out an exact test to time of a series of three globes housing electric lamps. All these three globes, it appeared, came safely through the ordeal.

There was a brief but informative discussion, in which Dr. S. English, Dr. W. M. Hampton, and some others with special knowledge of glass manufacture took part.

MODERN LIBRARY LIGHTING

A Description of the Lighting of the New Lending Library at Luton. The novel method of fitting Troughs into the tops of the Book Racks was adopted.

The lighting of a modern library is a matter well worth study. Here is a case in which the whole object of the building is to enable people to use their eyes—in reading the books provided. When so much care is devoted to the selection of books likely to be acceptable and their storage, so that they may be quickly accessible, it is certainly worth while to make sure that the lighting enables them to be read with ease.

In a lending library good lighting is particularly needed in the interests of the staff, who may have to work at high pressure during the evening periods when the library is most in demand, and when artificial lighting is necessarily used. Special features in such circumstances are that (1) much of the available space is occupied by shelves and other furniture, and (2) approximately "shadowless" illumination is necessary, so that the light can penetrate between racks of books and into every corner, and also in order to avoid the possibility of people getting

Fig. 2. New Lending Library, Luton. Night photo showing the effect from 200W. lamps in Holophane semi-indirect pedestal Units.

Fig, 1. New Lending Library, Luton, Night photo showing the effect from Holophane Extensolite Troughs concealed in the top of the book racks.

"in their own shadow" when inspecting the titles of books on shelves. Yet another consideration is the avoidance of troublesome reflections of light sources, in the shiny surfaces of volumes or the gilt lettering.

In view of these considerations a somewhat unusual method was adopted in the new Lending Library in Luton. Holophane, Ltd., to whom the problem was presented, decided to adopt Holophane Extensolite Troughs, fitted with a light diffusing glass-cover and fixed into the tops of the book racks at a distance of 4 ft. 6 in. below the ceiling. Each of these trough units is equipped with two 150-watt lamps. The resultant effect of reflection from the matt ivory ceiling finish proved to be very satisfactory, and the method is considered an ideal one in these circumstances. The sources of light are completely concealed from view. There is therefore no glare or any evident bright surface liable to give rise to troublesome reflections of the kind mentioned above. The illumination of the racks is such that even the smallest titles can be read with ease, and, as the adjacent photograph illustrates, the light is fully diffused and penetrates into every corner.

At the entrance counter (Fig. 2) there were no facilities for concealing trough units, and accordingly four semi-indirect pedestal units, each equipped with 200-watt lamps and extensive prismatic reflectors, were adopted. The units have a pleasing appearance, and in this case also the effect of the diffused lighting has proved entirely satisfactory.

ERRATA.

We have been asked to correct two little oversights in our last (February) issue.

Firstly, the photograph which headed the account of the **Benjamin** installation in the drawing office of Messrs. Vickers (Aviation), Ltd., p. 68, was taken by the *artificial* light of the actual lighting units, *not* by daylight. (In a way, however, this misdescription was a compliment.)

Secondly, we regret that, by an oversight, the name of **Hanovia, Ltd.**, was omitted from the list of names of firms who contributed apparatus in connection with Mr. Lamplough's paper on January 14 (p. 48). We gladly rectify this omission, which will also be made good in the final account of this meeting in the "Transactions."

Literature on Lighting

(Abstracts of Recent Articles on Illumination and Photometry in the Technical Press)

(Continued from February, Page 53)

I.—RADIATION AND GENERAL PHYSICS.

58. Temperature Distribution and Electron Density in Free-burning Arcs.

H. Hörmann. Zeits. f. Physik, 97, pp. 539-560, 1935.

The longitudinal field strengths in free-burning and stabilised arcs at atmospheric pressure have been newly determined. For the carbon arc it is shown that the previously accepted value of b in the Ayrton equation is about twice its proper value. The ionisation of the carbon arc is not much altered by impurities in the carbon. A method is given for calculating the specific radiation density over the arc cross-section from the observed intensity distribution of spectral lines over the cross-section and an Abel integral equation. The temperature distribution over the cross-section of the arc is then found with the ordinary radiation formulae. Further results are also obtained with regard to the ionisation potential of the arc gas. T. H. H.

59. Intensity Variations in the Channel of the Return Lightning Stroke.

D. J. Malan, B. F. J. Schonland and H. Collens. Nature, 136, p. 831, November 23, 1935.

Photography shows that each lightning stroke is of a dual nature, consisting of a leader and return portion. The former passes through branches from a cloud to a main channel from the cloud to the earth. The return stroke pursues the same paths in the opposite direction. The return stroke may consist of up to six components which follow each other at intervals of about 1/10000 sec. The subsidiary components are attributed to the induced charge on the earth by the various branches. T. H. H.

II.—PHOTOMETRY.

60. A Double-Baly-Tube for Absorption Measurements in Coloured Solutions.

F. Bandow. Z. f. Instrumentenkunde, XI., pp. 464-5, November, 1935.

A photograph of this apparatus, as made by the firm F. Hellige, of Freiburg, is shown. The two tubes containing the coloured solutions are arranged one above the other. A single adjustment controls their length, which is the same, and which can be read with a vernier to 1/10mm. The apparatus fits on an ordinary optical bench, and is adjustable about a vertical axis and laterally. A sector disc is used in connection with the beam of light through the lower tube. The method of filling the tubes with the liquid is simple. T. H. H.

III.—SOURCES OF LIGHT.

61. Tungsten Filament General Service Lamps Electric British Standard Specification No. 161—1936.

A revised version of the previous (1934) version of this specification, divided into main sections dealing with definitions, specifications (dimensions, initial watts, and efficiency, life performance, etc.), and schedules for lamps for general service. There are now two schedules dealing respectively with single coil and "coiled coil" lamps. The latter is a new feature in this specification. J. S. D.

62. Luminous Discharge Tubes.

C. C. Paterson. Elect., 116, p. 127, January 31, 1936.

Developments in luminous discharge tubes that have taken place during the past year are discussed. Luminous powders and super-pressure lamps are dealt with. C. A. M.

63. Resonance Radiation in Discharge Lamps.

C. E. Fenwick and J. Soper. El. Rev., Vol. CXVII., No. 3,035, p. 122, January 24, 1936.

A description of resonance radiation phenomena is given, with a suggestion that a means of estimating low vapour pressures could be developed. R. G. H.

64. Miners' Safety Lamps.

E. Lyon. Elect., 116, pp. 93-94. January 24, 1936.

An abstract is given of a lecture by the author to the London Technical Group of the Association of Mining Electrical Engineers on the design, characteristics, and performance of miners' safety lamps. The permissible limits of current and lumen output for the lamps used, and results obtained, are shown on a "target" diagram. C. A. M.

65. A New Low-Pressure Gas Lamp.

Gas Journal, February 29, 1936.

Contains an article, with illustration, of a new low-pressure gas lamp having a forced primary air supply produced by an electrically-driven propellor. J. G. C.

V.—APPLICATIONS OF LIGHT.

66. Engineering Achievements of 1935. (20) Illumination.

H. W. Cope. Electric Journal, Vol. 33, No. 1, p. 48, January, 1936.

Reviews new lamp developments, street lighting by discharge lamps, and the use of mercury vapour discharge lamps for interior lighting. R. G. H.

67. Street Lighting.

Anon. Elect., 116, p. 70, January 17, 1936.

Details, with a photograph, are given of street lighting installations at Egham using mercury luminous-discharge lamps. Illumination values obtained are included. C. A. M.

68. Street Lighting.

Anon. El. Times, 89, p. 127, January 23, 1936.

Three short articles dealing with installations of mercury-vapour lamps and sodium lamps. Photographs are given. W. R. S.

69. New Lighting at Stepney.

El. Times, 89, p. 35, January 9, 1936.

Photographs to show the improved lighting at Stepney. The lanterns used are arranged so that mercury-discharge lamps can be used in place of the existing tungsten-filament lamps as soon as the supply is altered from A.C. to D.C. W. R. S.

70. Control Street Lights Over Primary Circuit.

Anon. El. World, 106, pp. 256 and 268, January 18, 1936.

A brief report is given of a new polarised control system for regulating the operation of street lights and off-peak services. This system utilises directional D.C. impulses, sent out over the primary-distribution neutral or a pilot wire, to actuate polarised relays at each street light. S. S. B.

71. Carrier Current Controls Hollywood Street Lights.

O. W. Holden. El. World, 105, pp. 2,886-2,888, December 7, 1935.

The article describes the system of control of the 10,000 street lights in ten square miles of Hollywood by carrier current. A 700 cycle impulse is used, and full details of

the equipment are given. It is claimed that although the effect of the impulse can easily be detected on the telephone system, the noise level is so low as not to form a cause of complaint. S. S. B.

72. Europe Abandoning "Flat" Floodlighting.

A. L. Powell. El. World, 106, p. 254, January 18, 1936.

In an attempt to avoid the flat appearance of architecture illuminated by several sources, with a resulting tendency to loss of shadows, a trough parabolic floodlight, to be used with a number of high wattage lamps, has been developed by a Paris company. It is stated that this unit produces brilliant high-lights and deep, strong shadows, with excellent effect. It may be used to floodlight large areas also. Installations cited are Rheims Cathedral, the Forum at Rome, and the Market Square at Brussels. S. S. B.

73. Flood Lighting of Church.

Gas Journal, January 22, 1936.

Contains an illustrated description of a church near London, flood lighted by gas. J. G. C.

74. Illumination of a Football Ground.

Gas Times, February 1, 1936.

Contains an illustrated description of gas lighting equipment for the illumination of a rugby football ground, so that the game can be practised in the winter evenings. J. G. C.

75. San Francisco Bay Bridge.

Anon. Elect., 116, p. 203, February 14, 1936.

Details are given of the lighting equipment of the San Francisco Bay Bridge, claimed to be the world's largest sodium lighting scheme. Series circuits are used, employing 6,000 and 10,000 lumen sodium lamps. A photograph of the lantern, with a description, is given. Metallic reflectors made of anodically polished aluminnium are used. C. A. M.

76. Train Shed Gets More Light.

Davis E. Tuck. El. World, 106, pp. 218-220, January 18, 1936.

The article deals with the re-lighting of a Chicago train shed. Parts requiring special consideration and the method of selecting the lighting equipment and mounting position are discussed. S. S. B.

77. Illuminated Tree.

Anon. Elect., 116, p. 89, January 24, 1936.

Particulars, with a photograph, are given of an illuminated tree in Ferndale, California. The tree is 118 ft. high, with a spread across its branches of 50 ft.; 500 lamps of various colours are used, with additional luminous devices both at the top and the base of the tree. C. A. M.

78. Lighting of the William Rockhill Nelson Gallery of Art and Atkins Museum of Fine Arts in Kansas City, Missouri.

H. L. Hutchinson and W. H. White. Am. Illum. Eng. Soc., Trans., XXX., pp. 453-473, June, 1935.

The galleries are lighted throughout by artificial light. Generally, the system employed is a laylight with specially directed lighting through the laylight for the pictures. The installations in the various galleries are described in detail. G. H. W.

79. Neon Lighting.

Anon. Elect., 115, p. 815, December 27, 1935.

A description, with a photograph, is given of the lighting of the Brighton Information Bureau at Victoria. High frequency currents, used to obtain complete safety, are supplied to the Neon tubes. C. A. M.

80. Dominion Theatre, Harrow.

Anon. Elect., 116, p. 179, February 7, 1936.

Details, with photographs, are given of the lighting equipment at the Dominion Theatre, Harrow. C. A. M.

81. New Greenhouse Electric Light and Heat.

Anon. El. World, 106, p. 261, January 18, 1936.

Experiments on a totally heat-insulated type of greenhouse, with one window only, on the south side, but employing filament lamps in reflectors, have shown that with proper control plants can be raised in one-third normal greenhouse time. About four hours a night burning is sufficient for this result. S. S. B.

Reviews of Books

Neon Signs, by S. C. Millar and D. G. Fink. (McGraw-Hill Publishing Co., Ltd., London, 1935; pp. 288; figs. 105.)

This book on neon signs strikes us as one of the best we have seen. Although primarily intended as a guide to the making of the tubes, it contains a good deal of useful information in regard to installation and maintenance, and hints of value to users as well as manufacturers are given. The book is divided into two main sections on "Fundamentals" and "Shop Practice"—the latter is much wider than the title conveys. In an introductory chapter the growth of the neon-sign industry is briefly traced, and four subsequent chapters deal with the nature of the tube, the materials and electrical equipment, and types of signs for indoor and outdoor work. The next five chapters, in Part II., deal mainly with manufacturing operations, the three next with installation, maintenance, and special applications. The final chapter, "Tricks of the Trade," is less exciting than the title suggests. It merely gives a few supplementary hints on dodges of a quite legitimate character. In Chapter III. some useful tabular data on light output (lumens per foot) of neon tubes and the distance at which letters of specified size are visible are given. (It is somewhat curious that figures for *brightness* are rarely given, and the relation of brightness to visibility is not much discussed.) In "special applications," the use of the tubes for producing stroboscopic effects (studying moving machinery) and television are mentioned. There are no doubt many others to come. Underwriters' requirements (U.S.A.) for electric signs are summarised in an appendix. The type and illustrations are excellent.

Fluorescence Analysis in Ultra-Violet Light, by J. A. Radley and J. Grant. Edited by E. Howard Tripp. (Chapman and Hall, Ltd., London, 1935; pp. 308.)

The second edition of this standard work makes a timely appearance this year and should attract those whose interest in this subject has been excited by Mr. Lamplough's recent contribution to the Illuminating Engineering Society. Readers will learn with some surprise of the extraordinary range of applications of this process of "fluorescence analysis." The first part of the book is introductory and explains the chief methods of producing ultra-violet rays, the sources and filters available, the measurement of the intensity of these sources, and the general technique of fluorescence analysis. Mercury lamps form the usual source, equipped with special filters, but arcs and other sources can be used, and there is even an apparatus based on the selection of the radiation in daylight. There is an excellent diagram illustrating the chief characteristics of the sixty-two octaves of electro-magnetic waves. The five octaves of ultra-violet radiation can be divided into six main classes according to their uses. Methods of analysis take several forms. Visible fluorescence may serve as a test, or the fluorescence may be photographed or analysed with a colorimeter. By fluorescence microscopy again features invisible by ordinary light may be revealed. The series of nineteen chapters in Part II. roam from "agriculture" to "waters and sewage." and many curious applications are revealed. Such special fields as the study of drugs, oils, fats, and lubricants, foods and food products, are treated in chapters furnished with hundreds of references. Lovers of the sensational will find the chapter on legal and criminological work of special interest. At the conclusion of the book there is an adequate index and a series of effective luminograms showing how effective the process may be in special instances. If we may be allowed one little quarrel with the authors, we would urge "Ultra-Violet Radiation" is preferable to "Ultra-Violet Light" in the title. "Light" should surely be reserved for visible radiation.

Recent Patents

(Abstracts of recent Patents on Illumination & Photometry.)

No. 438,630. "Improvements in Photometers."
The General Electric Company, Limited, and Waldram, J. M., October 3, 1934.

This specification relates to photometers for rapidly measuring the brightness of a distant surface, such as a road surface. The photometer comprises a relatively large aperture through which the surface is viewed, and a series of small comparison areas illuminated each to a different but known brightness and capable of being brought into apparent juxtaposition. The small areas may be provided by a surface such as that of a translucent strip illuminated with regularly varying brightness. The illuminant of the comparison areas may be an electric lamp, and a filter may be interposed between it and the comparison areas.

No. 438,679. "Improvements in or Relating to Epidiascopes."
Aldis, A. C. W., September 22, 1934.

According to this specification in an illuminating system of an epidiascope, comprising back, front, and side reflecting surfaces, the back and front ones are concave, and are arranged respectively behind and in front of the light source, whilst the side reflectors consist of flat surfaces, each adapted to reflect light incident on its surface over the whole of the area to be illuminated.

No. 438,830. "Improvements in or Relating to Electric Incandescent Lamps for Vehicle illumination."
N. V. Philips, Gloeilampenfabrieken, December 22, 1933. (*Convention, Germany.*)

This lamp bulb has two filaments with straight axes arranged normally to one another, their relative positions being such that the main filament is normal to the road surface, and the auxiliary filament is parallel to that surface and at some distance above the horizontal meridian plane of the bulb. The two filaments thus preferably form a T.

No. 439,593. "Improvements in and Relating to Electric Lamps, Electric Discharge, and like Devices Having an Energy Translating Element in a Sealed Bulb."
The British Thomson-Houston Company, Limited, November 29, 1933. (*Convention, U.S.A.*)

According to this specification one of the leading-in wires of an electric lamp, or the like, having a sealed envelope is connected to an inwardly projecting lug or flange of a metal ring, which is sealed to the open neck of the bulb, and the other leading-in wire is connected to an insulated contact carried by the metal ring. The metal ring is provided with outwardly projecting flanges for engaging and locating the ring in a socket.

No. 439,730. "Boundary Beacon Light for Air Ports."
Curran, E., February 12, 1935.

This specification describes a boundary light for air ports, comprising a bollard with a head having an electrical light source, supported upon a base having a male or female seating surface fitting a complementary seating surface of the bollard, e.g., a cup and ball joint, so that the latter is normally supported upright, but may be freely upset by impact of an aircraft or other vehicle. The circuit of the light source is carried over contacts in the base and bollard so that the light source is completely disconnected when upset. The head may comprise a reflector, for distributing light downwards, and an illuminated lens or other transparent or translucent surface.

No. 439,983. "Improvements in Miners' Safety Lamps or the Like."
Hailwood, E. A., July 7, 1934.

This specification describes a miner's lamp with an adjustable atmospheric intake tube, which permits samples of the atmosphere to be drawn into the lamp, for testing, from above, on a level with or below the lamp. Various forms of intake are described, of which one is similar to a walking stick, which may be attached to the lamp and may incorporate a pump or bellows.

No. 440,251. "Improvements in or Relating to Photo-Electric Cells furnished with Shading Means."
Falkenthal, E., and Presser, E., September 1, 1934. (*Convention, Germany.*)

According to this specification the shade of a photo-electric cell, for cutting off light falling outside a certain angle, comprises a series of rods projecting from the cell surface, but not forming chambers there between. The rods are preferably thin sheets or slats and may be cross-shaped in section.

No. 440,293. "Improvements in and Connected with Anti-Dazzle Devices for Vehicle Head Lamps."
Strange, A. L., November 20, 1934.

A projector for producing a beam having a segmental portion dim or omitted, according to this specification, has a reflector comprising two parts united or merging in a plane at right angles to the axis of the lamp and containing the foci of the two parts, the foci, however, both being displaced with respect to the light source, that of the rear part being slightly below, and that of the front part slightly to one side of the light source, so that the rear part projects a beam at a slight angle downwards and the front part projects a beam to the side.

No. 440,455. "Improvements in or Relating to Incandescent Electric Lamps."
Conti, J. T. F., November 30, 1934.

This specification has for its object a lamp producing a wide flattened beam for illuminating large surfaces. The lamp comprises a reflector generated by rotation of a planar curved line, consisting of the opposite branches of two co-axial parabolas of different focal length having a common vertex on the axis, about a line at right angles to the common axis. The light source is preferably a circular arc concentric with the axis of rotation of the curved line, and is disposed between the circular arcs generated by the foci of the parabolas. The reflecting surface may form part of the lamp bulb.

No. 440,779. "Improvements in or Relating to Light Signal Beacons."
Bartow Beacons, Inc., May 26, 1934. (*Convention, U.S.A.*)

This specification describes a signal beacon, comprising an annular lens system having equatorial zones to produce respectively horizontal broad sheets of light, each to represent to an observer a dash, horizontal narrow pencils, each to represent to an observer a dot, and a broad sheet inclined upwardly to be viewed by an elevated observer.

EVERYDAY PHOTOMETRY

(1) Is the Inverse Square Law Always True?

Setting aside such considerations as kinks of space and light "caught bending" by Einstein—with which, very fortunately, the terrestial illuminating engineer need not concern himself — there can surely be no doubt that the inverse square law itself *is* always true. Correctly stated, the law asserts that the intensity of light or other radiation emitted from a point in space diminishes inversely as the square of the distance from the point at which this radiation is measured. So long as light continues to travel in straight lines, this fundamental law of radiation always holds.

But it is also true to say that the illuminating engineer can never apply this law with absolute precision, because he never meets a case of light radiating from a mathematical point. Usually he has to deal with light coming from a number of closely adjacent points. In such simple cases an approximation is made by assuming that the effect is the same as if all the light were emitted from the "centre of light" of the source, the position of which we estimate as nearly as we can.

In more complicated cases in which the points of light are scattered over a relatively large surface, the calculation may become more difficult.

What, then, is the result of these considerations in everyday photometry such as is practised on a typical photometric bench?

"Sideways-Spread" of Sources.

Here we may conveniently consider two sources of error. There is, firstly, the fact that sources of light spread out laterally at right angles to the line of the photometer bench, so that rays from the more distant regions have to travel a little further before reaching the photometer screen (which, incidentally, they also do not strike quite vertically). The magnitude of this lateral error, as we may call it, has been conveniently shown in a diagram in Dr. Walsh's familiar book on photometry.* From that diagram it can be seen, for example, that if our source of light instead of being a point is a disc of radius r, and if the distance of the photometer-face from the source is a, then if r/a does not exceed 0.1 the percentage error due to deviation from the inverse square law will not exceed 1 per cent.

This is surely a comforting result. It means that in practice we have only to make sure that the extreme diameter or "spread" of the source tested is not more than one-fifth our distance of measurement; we can then be sure that the resultant error will not exceed 1 per cent.—surely enough in all commercial work.

Displacement of "Centre of Light."

A somewhat more serious source of error, however, may be caused by displacement of the "centre of light" of the source along the line of measurement. If, for example, the photometer is four feet away, and we make an error of one inch in determining the position of the centre of the light-source, then the assumed distance of the photometer will be 2 per cent. wrong, and the resultant error (in view of the squaring of the distance) twice as great, i.e., 4 per cent. This and the preceding source of error can, of course, be minimised by working at longer distances. Thus if the photometer were twelve feet away the error would be only a little over 1 per cent. It should be remembered, however, that as the distance becomes greater the illumination of the photometer face becomes less, so that at great distances the accuracy of work is in some degree affected.

When we are dealing with symmetrical light-sources the errors involved are usually small. Where exactly is the light-centre of an incandescent mantle, or a "pearl" electric filament lamp?—probably not exactly the geometrical centre but yet not far removed from it. In the case of luminous columns of gas, such as occur in electrical discharge lamps, the error involved in assuming that the light-centre is on the vertical axis of a short vertical column of gas is also small.

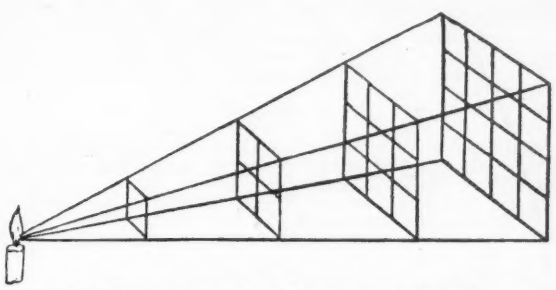


Fig. 1. This diagram presents the inverse square law in its essential form. It is evident that as the distance from the source is increased *twice*, *three times*, and *four times* the area embraced by the same flux of light is increased *four*, *nine*, and *sixteen times*, so that the illumination is reduced to 1/4th, 1/9th and 1/16th—i.e. inversely as the square of the distance. The relation is true for each minute incandescent particle in the candle-flame, here shown as the source, but the candle-flame has a certain size and these particles are not all situated at exactly the same point in space.

It is a fortunate fact that an evenly bright sphere behaves, in a photometric sense, as though its light was concentrated at its geometric centre. When, therefore, we have a filament or mantle within a diffusing globe which appears evenly bright all over or when, which is more usual, we can see the central source with the globe forming a sort of luminous envelope, we are on fairly safe ground in making our measurement from the centre of the globe. In the case of sources enclosed in diffusing envelopes of different shapes (cubes, rectangles, etc.), the position is less clear, though the error involved in taking the centre of the object for the "centre of light" is not usually very great.

Combination of Source and Reflector.

The most difficult case, in a photometric sense, is doubtless the lighting unit which consists of a combination of the source itself and some form of reflector. Taking first the simpler case of a filament or mantle with a diffusely reflecting surface behind it. We have here *two* sources of light, the actual source yielding direct light and the reflector furnishing diffused light. If the reflector receives upon it a considerable proportion of the flux of light from the

* "The Elementary Principles of Lighting and Photometry," p. 33.

original source of light it may make a substantial contribution to the total candle-power. Light emitted by each of the numerous minute points of light of which this reflecting surface is composed obeys the inverse square law, but the aggregate effect is less easy to estimate. It is often not easy to say precisely where the centre of light of the reflector is situated. This applies particularly to non-assymmetric units such as the lamps with parabolic or inclined plane surfaces behind them. Nevertheless, if the distance of measurement is made great in comparison with the dimensions of the light source the probable error will not be serious.

Lastly, let us take the type of combination unit consisting of a source of light equipped with some form of polished or semi-polished curved mirror surface. Can this be regarded as in the same category as those just discussed—or does the inclusion of a curved more or less "focussing" mirror mean that we have here an element to which the inverse square law does not apply?

What Happens in the Case of a Searchlight?

The answer to this question is best obtained by considering an extreme case, namely, that of a search-

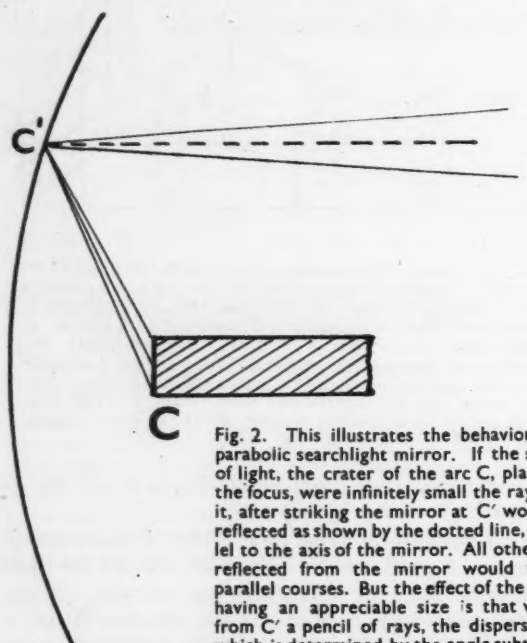


Fig. 2. This illustrates the behaviour of a parabolic searchlight mirror. If the source of light, the crater of the arc C, placed at the focus, were infinitely small the ray from it, after striking the mirror at C' would be reflected as shown by the dotted line, parallel to the axis of the mirror. All other rays reflected from the mirror would follow parallel courses. But the effect of the crater having an appreciable size is that we get from C' a pencil of rays, the dispersion of which is determined by the angle subtended by the crater-source at this point. Although this angle of dispersion may be very small the rays in each pencil diverge uniformly. The light emerging from any point C' therefore follows the inverse squarelaw. This applies to every other point on the mirror, which thus becomes, in an optical sense, the source of light.

light. Here the source of light is minute, all the light in the beam is obtained by reflection, and the reflecting surface is of a highly focussing character. It is not unusual to find people who regard the searchlight as a special case, believing that, since the source is at the focus of the parabolic mirror, all the rays must emerge parallel—so that the illumination will not obey the inverse square law and (except for atmospheric absorption) remain substantially constant and independent of distance.

This belief is, in practice, unfounded. What actually happens is simply that the mirror-surface becomes to all intents and purposes the source of light, to each element of which the inverse square law applies. The only difference from the case of a source equipped with a matt diffusing surface is that the light, instead of being spread over 180°, is confined within a narrow angle, which may be as small as 2°. The angular spread depends simply on the angle subtended by the crater of the arc at any point on the mirror. In practice the crater or other source of light has always *some* dimensions, therefore the reflected rays must diverge at a slight angle.

If we could introduce a point-source absolutely without dimensions the angle of divergence would be infinitely small, all rays would emerge exactly parallel, and the illumination, except for atmospheric absorption, would remain constant. A parabolic mirror with a point-source at its focus would thus, in fact, constitute an apparatus to which the inverse square law could not be applied. The same might be said of an elliptical surface, the characteristic of which is that each ray from a point-source at one focus must pass through the other focus, or a hyperbolic surface in which the second focus is removed beyond infinity! The effect of such special reflectors, whereby the natural course of rays is distorted, can hardly be cited as exceptions to the inverse square law. (There is also the further consideration whether a point of infinitesimal size could furnish any light at all!)

Lighting Units with Polished or Semi-Polished Reflectors.

What applies to such an extreme case as a searchlight will evidently apply to ordinary lighting units making use of regular reflection by means of polished surfaces. The inverse square law will apply both to the source itself and to each element of the reflecting surface, whether matt, polished, or semi-polished. The only difficulty is the decision where the light-centre is situated.

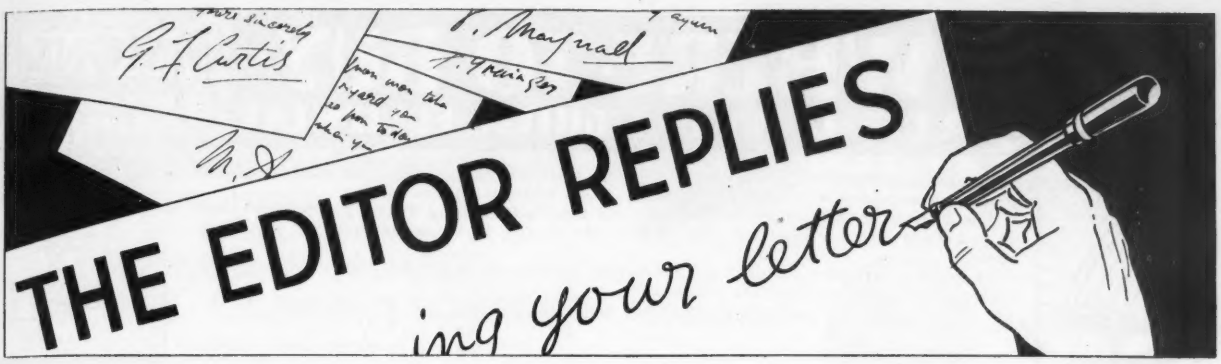
In the photometric laboratory the errors to which this uncertainty may give rise are of some moment They can be avoided by stating the "apparent" candle-power corresponding with the production of a certain illumination at a specified distance. But if the testing distance corresponds, roughly, with the distance at which such units are commonly applied in practice—which may be, perhaps, 8 to 20 ft.—uncertainty about the exact position of the light-centre is not of great consequence, and in making calculations the inverse square can be applied with quite sufficient exactitude for all ordinary purposes.

Long Tubes of Light, Illuminated Ceilings, etc.

The practical cases in which there is apparent departure from the inverse square law—for example, masses of lights mounted near together, illuminated ceilings, long tubes of light, and other cases in which the dimensions of sources taken as a whole may be as great or greater than the distance of things they are used to illuminate, will be considered in a further article. It will be found that such difficulties are at least comprehensible. They can usually be avoided either by dividing the large luminous area into portions to which the inverse square law does approximately apply; or by making use of processes based on the consideration of the total flux of light in a room which, though empirical, in practice work surprisingly well.

Next Month :

"THE COSINE (LAMBERT'S) LAW"



" Depend upon it, Sir, the ignorant man who has wit enough to continue asking sensible questions will not remain ignorant very long ! "

Wanted, a definition of **" Floodlighting."** Our recent note on " Floodlighting without Fuss " has brought the rejoinder that merely hiding the lamp is not floodlighting at all! We can't agree with this, but, quite seriously, a definition of floodlighting seems needed. Surely the leading characteristic of floodlighting is that the source shall be hidden—yet we read in the daily Press of a " £4,000,000 Plan to Floodlight Roads," when ordinary street lighting is intended. The public seems to be forming the habit of describing all schemes for the improvement of illumination as " floodlighting."

A letter from Sweden convicts us of fault. Dr. E. Elvegard, of Stockholm, whilst kind enough to say that the note in our last issue (p. 39) on **" The Correct Sequence of Wattages for Electric Lamps "** reproduces exactly the leading ideas of the original contribution to " Licht und Lampe," points out a little slip. The standard series ought to be "from 15 to 2,000 watts, or 4,000 Decalumens respectively." He also points out a more grievous error—that he himself (and not Dr. Schaer) was the author of the article! We regret the error and gladly give Dr. Elvegard credit for this interesting contribution.

We are asked from time to time where **installations of sodium vapour lamps** in this country may be seen. The original Philips installation on the Croydon Bye-Pass-road is familiar, and we hear that there is also a fairly extensive one near Aylesbury. Can any readers inform us of others—more especially in the Midlands and North of England?

A correspondent has asked us for details of a **New form of gas lamp** mentioned in the I.E.S. Annual Report of Progress issued in October last. These " new Humphrey super power " lamps operate on low pressure gas, but high candle-power is obtained from a small " super charger " built into the bracket attachment, which we understand makes use of a small electric motor to create a forced draught. A series of five units of 3,000 c.p. each were exhibited by the Grand Rapids Gas Light Company (U.S.A.) in June last. (See " Gas Age Record," July, 1934, p. 7.)

The idea of getting enhanced efficiency with low pressure gas by some form of forced draught is not new. One recalls, for instance, the long chimneys adopted with Lucas " self intensifying " lamps about twenty-five years ago, and the small fan, driven by current set up by a thermophile in the Welsbach-Kern lamp of about the same date. Apparently, in the case of the Humphrey lamp the small motor is driven off the electric supply, so that it may be regarded as a joint effort!

Another problem that has been brought to our notice—mainly in connection with gas mantles, though it applies to other illuminants—is the **effect of obstruction** by one source of light getting in the way of another. It has been suggested that one mantle at least partly blocks the light from another behind it, and that therefore a series of mantles in line should give, on the whole, more light than the same number bunched in a cluster.

The matter, however, is not quite so simple as this. In a paper presented to the London and Southern Junior Gas Association in 1934, Mr. L. T. Munchin pointed out that there are two conflicting effects at work, the " blockage " referred to above and the fact that radiation from adjacent mantles tends to increase their temperature and therefore also their efficiency. The ultimate result, therefore, will no doubt depend on the number of mantles and their distance apart.

As, we believe, this question may be amongst those to be discussed at the I.E.S. informal meeting on March 31, it may be better not to pursue it further at the moment—except to say that it may also arise in the case of **tubular sources containing luminescent gases and vapours;** conditions in this case are also somewhat complex, as much depends on the behaviour of the contents of the tube.

Such blockage, one imagines, is liable to occur when a **number of sources in diffusing globes** are mounted close together on pillars, a form of street lighting sometimes described as the " White Way " system. The aim in such cases is usually decorative, and the relatively small loss of light by obstruction is not of serious moment.

We have been asked, however, whether there is any positive advantage in **mounting two or three lighting fittings on a pole** instead of one unit of similar aggregate power. A symmetrical group of three might be preferred by some on aesthetic grounds, and the effect of sub-division of sources tends to produce less sharp shadows.

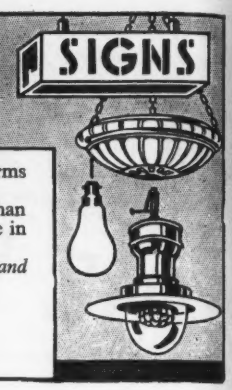
There is also the possible advantage, seeing that in these days reflection from the polished road surface counts for so much, of having more bright reflected patches. In North London a method of mounting two Rodalux units on a swan-neck fitting, one above the other, and also somewhat nearer the kerb, is to be found. We believe, however, that there is no very marked advantage to be gained from this arrangement—except, of course, the advantage common to all multiple fittings, that **one or more may be switched off at midnight** and the illumination diminished without the distribution of light on the roadway being sensibly altered.

Our attention was drawn some little time ago to the claim, ascribed to a young inventor in Vienna, that he could make objects disappear, that he had, in fact, solved the problem of **" the invisible man."** In order to get first-hand information, we asked Dr. Hans Koch, a member of the I.E.S. resident in Vienna, to make inquiries. Unfortunately, the inventor seems to have himself attained invisibility; at any rate, Dr. Koch could find no trace of him!

One rather gathers, however, from hints let fall in newspaper interviews, that he relied on **the use of ultra-violet rays.** We should probably not be far wrong in assuming that his process is based on fluorescence, applied in the manner so strikingly illustrated by Mr. F. P. Bentham at a recent meeting of the Illuminating Engineering Society.

We are not sure whether the reader who draws attention to the **" Society of Scribes and Illuminators "** is to be taken seriously or whether he is pulling the editorial leg. There is no harm in stating, however, that the body in question bears no relation to the editorial staff nor to the Illuminating Engineering Society. Its main object, we understand, is to revive the art of handwriting and illuminating manuscripts, of which some fine examples are on exhibition in the rooms of the Architectural Association.

WHERE TO BUY
A DIRECTORY OF LIGHTING EQUIPMENT



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Index to "Where to Buy"

N.B.—The numbers are those attached to individual entries in the Directory (See pp. 90-92.)

I.E.S. Informal Meeting

QUESTIONS AND ANSWERS

A second informal meeting of the Illuminating Engineering Society has been arranged to take place at St. Ermin's Hotel, Westminster, on Tuesday, March 31. After light refreshments have been provided at 6.30 p.m., the evening will be devoted to "Questions and Answers." Mr. F. C. Smith will preside.

We understand that a number of queries have already been put in, dealing with such points as the effect of cluster sources (i.e., one source behind the other, as in the case of gas mantles bunched together), the definition of brightness in a source, the difference between a "white lumen" and a "red lumen," and the behaviour of the integrating sphere when a reflecting power approaching 100 per cent. is secured. These are all interesting topics, but as it happens, they are mainly of a photometric nature; some installation and maintenance problems would be welcome. There is still plenty of time for members to send in some real "teasers" before the meeting.

Sir Walter Scott as a Gas Engineer

Sir Walter Scott, the great novelist, was a man of enthusiasm too ready to embark on ventures other than those for which he is justly famous. Indeed, his name appeared so frequently in the Scottish newspapers as being a president or chairman of some business concern that strangers to Edinburgh were apt to conclude that there must be another Sir Walter besides the immortal author! He was, however, less successful in business matters than in his literary labours.

We are indebted to the Rev. Arthur Hedley, of Flitwick, for the following account of one adventure of some interest to those in the lighting field. The author of the Waverley novels, he recalls, was an enthusiast for gas lighting, then being gradually introduced into Scotland. He had it laid on to every room in Abbotsford, and informed his friends with glee that with a gallon of the basest train oil he could make a hundred feet of gas—and treble that quantity, he said, "lights the house in a state of illumination for an expense of 3s. 6d." Spermaceti oil and wax candles, he declared, gave only one-tenth of the light obtained from gas, and he emphasised the great saving of labour to the domestic staff. About twice a week the gas was made by an ordinary labourer, about five hours being required to fill the gasometer. His guests were much impressed when, by the turning of a screw, the room was filled with a brilliant light "worthy of the Palace of Aladdin." Jewellery sparkled, but cheeks and lips looked cold and wan in the fierce illumination! Captain Basil Hall, a guest, remarked that "the public rooms were lighted in a style of extraordinary splendour." Sir Walter himself exclaimed in delight, "I never saw an invention more completely satisfactory in its results."

Sir Walter's household, however, did not entirely share their master's enthusiasm. Sir Walter, it appears, did not use the light wisely. Moreover, faulty pipes and bad workmanship led to a perpetual unpleasant odour. It is also to be feared that Sir Walter deceived himself in regard to the cost, for, by a trick of the mind, he omitted many important items of expenditure.

Still, he was satisfied with the results, and may be regarded as one of the pioneers of gas lighting in Scotland. In the small Border towns where the famous author moved and lived are to be found some of the oldest gas companies in Scotland, and the Scottish Borderers of to-day for the most part use the same method of illumination as their illustrious predecessor.

Flashes

It is reported that Malden Council has approved a plan of "floodlighting" the Kingston by-pass, provided the M.O.T. and/or the Surrey County Council will pay a substantial proportion of the cost.

* * *

Swanage and Rothwell, which are both lighted entirely by gas, are making improvements in the existing installations. Modern lamps with up-to-date reflectors are being introduced. The Leeds Gas Department is experimenting with new methods of lighting, enabling pedestrians stepping into the roadway to be more readily seen.

* * *

Further improvements in the public lighting of Southwark are proceeding. The Borough High Street is to be lighted by thirty "Supervia" gas lamps, and in twenty-two of the more important side streets the lighting will be nearly trebled.

* * *

Hendon is to inspect trial installations of gas and electric lighting before taking a decision on improvements.

* * *

"Luminous Hair" is a novelty among ladies in Paris. Different washes, apparently giving a fluorescent effect, will impart lustre to grey, red, or blonde tresses.

The cathedral of Burgos, Spain is to have a permanent electric floodlighting installation consisting of fifty 1,000-watt lamps.

* * *

The San Francisco Bay Bridge, when completed will have the largest installation of sodium lamps in the world. In all 8,220,000 lumens will be furnished by 922 "Novalux" sodium units.

* * *

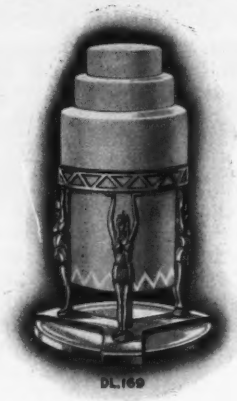
We learn that owing to ill-health Sir William Ray, M.P., has resigned his position as Executive Director of the British Electrical Development Association.

* * *

Camberwell's public library is to be floodlighted and various public buildings in Fulham are to be furnished with floodlighting equipment.

Modern Illuminating Glassware

Here are shown two attractive fittings which figure in a recent "Hailware" list. The table lamp on the left is of unusual design. The metalwork is supplied with copper bronze figures, other metal surfaces being chromium plated. The glass can be furnished in great variety—three ply white or various shades of coloured opal.



Light Table Lamp.

Outside Wall Fittings.

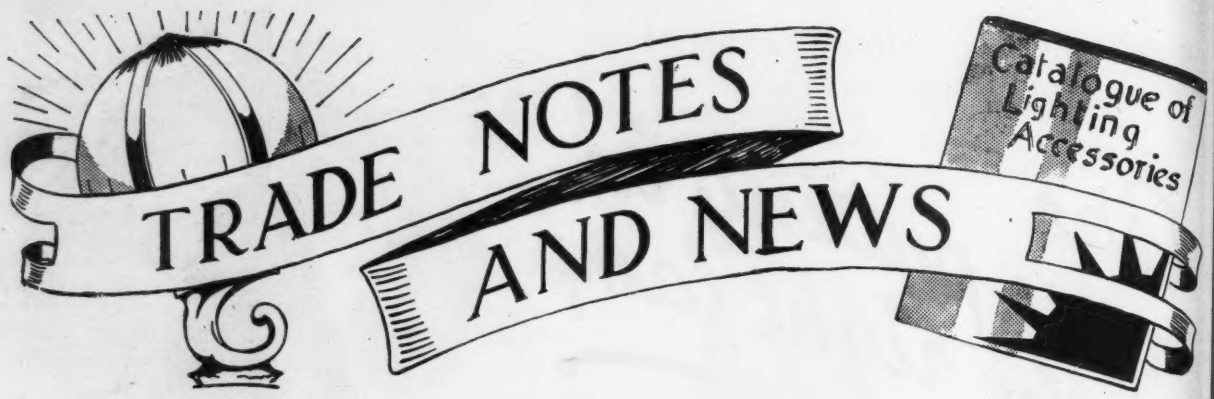
The metal of the outside wall bracket, shown on the right, may be painted in any approved colour or in real bronze, etc. The glass may be either opal or frosted and coloured clear glass.

B.T.-H. Contracts

The British Thomson-Houston Co., Ltd., have received substantial orders for Mazda Lamps from the City of Portsmouth (for street lighting); Scott's Shipbuilding and Engineering Co., Ltd., Lochgelly Iron and Coal Co., Ltd., and Anchor Line (1935), Ltd., of Glasgow, and from Llanelly and District Electric Supply Co., Ltd., and the Borough of Aberystwyth.

Change of Address

The Newcastle branch offices of Siemens Electric Lamps and Supplies, Ltd., have been removed from 44a, Westgate to "Siemens House, Carliol-square, Newcastle-on-Tyne," where more commodious premises have been taken. The telephone number (Newcastle 20641) and telegraphic address ("Siemens, Newcastle-on-Tyne") remain as before.



Ediswan Exhibit at Olympia

We hear that Royal Ediswan architectural lamps will be a feature of the company's display at the Ideal Home Exhibition, which opens at Olympia on March 24. Naturally, standard types of Royal Ediswan lamps will also be on view. A novel item will be the stereoscopic displays for home decoration and advertising—a new medium for the use of architects in devising panel pictures above fireplaces, illuminated wall decorations, dummy windows, etc.

New "Strand Electric" Director

Mr. Hugh M. Cotterill, late of Major Equipment Co., Ltd., has joined the board of Strand Electric and Engineering Co., Ltd. Mr. Cotterill, since taking his degree in engineering at Cambridge, has obtained valuable experience at the G.E.C. Research Laboratories at Wembley, afterwards joining in the formation of Major Equipment Co., Ltd. Mr. Cotterill is a member of the Illuminating Engineering Society, and his knowledge should be of great service.

The Largest Neon Sign

We see that the imposing neon sign installed outside the Ford Works at Dagenham is considered to be the largest in this country. The overall dimensions of the word "Ford," in script lettering, are 60 ft. high by 170 ft. long. One hundred and sixty steel panels, each 4 ft. wide and varying in length up to 16 ft., were used The face is finished in white enamel and the sign has a double outline of red Claudegen neon tubing.

The Ford Works already form a distinctive landmark in the day-time to ships passing up and down the Thames, and the sign should have an equally impressive effect by night.

There are certainly few advertisements that can compete with a vivid illuminated sign, either in regard to effectiveness or economy—especially when a favourable site is available.

HOLOPHANE FLAMEPROOF FITTING.

The above type of certified flameproof fitting has been developed by Holophane Ltd. Two types, the Pendant for 200 w. lamps and the Bulkhead for 100 w. lamps are available. The fitting satisfied Home Office requirements, and is well adapted for use in petroleum and chemical works, petrol stores, etc., and generally in works where explosive gases may be found.

Street Lighting in Edinburgh

The Public Utilities Committee of the Corporation of Edinburgh has recommended a rebate of £2,000 to the lighting department on gas used for public lighting during the present year—on condition that the sum is used exclusively for the improvement of light in gas-lighted streets. A diminution in the price of gas for public lighting during the next financial year of 2½d. per 1,000 cubic feet for the first 95,000,000 cubic feet and 2d. for the remainder is also recommended.

This concession for the benefit of public lighting, which, it is hoped, will be effected without any increase in the rates, might well be copied by other cities. It has often been urged that gas and electricity consumed for public lighting should be charged at specially low rates.

Benjamin "Saaflux" Glassteel Diffusers

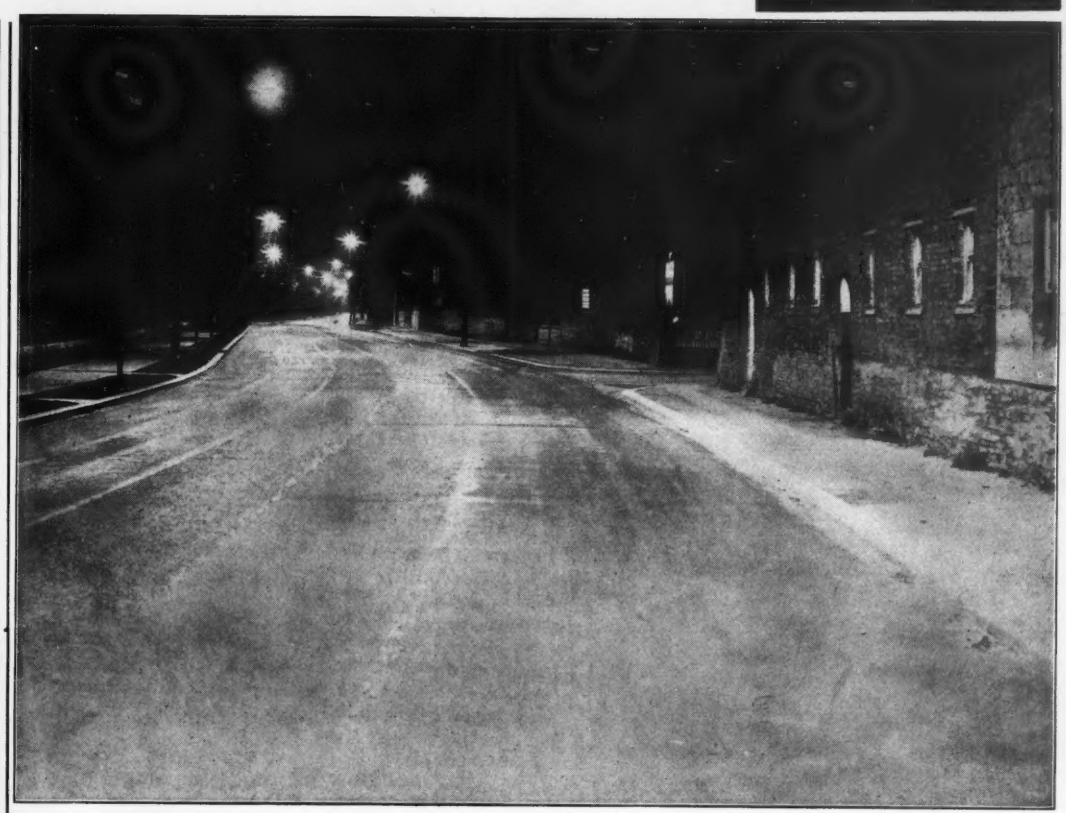
"Saaflux" Glassteel (Standard) Diffuser.

The modern trend towards simplicity and easy maintenance in industrial lighting is well illustrated in this Benjamin unit, which comprises a steel outer reflector with vitreous enamelled finish, white inside and out, and a diffusing globe, either opal or, in the daylight type, of blue diffusing glass. The complete fitting, with diffusing globe and lamp, can be instantly detached *as one unit*, for cleaning purposes, and the leaflet before us shows how easily the whole fitting is assembled. The standard type is for general office and factory work; the daylight variety is useful in textile warehouses, litho printing works, etc.

"Saaflux" Glassteel (Daylight) Diffuser.

"MAGNALITING"

—a solution to the problem of preventing street accidents at night



The REVO "Magnalite" Fitting for Gas-filled, Mercury vapour, and Sodium vapour lamps.

ABINGDON ROAD, OXFORD, *illuminated* by REVO "Magnalites"

Good street lighting is decidedly a prominent method of reducing the number of street accidents at night.

One cannot readily imagine an accident due to bad visibility occurring on the roadway shown in this picture. Such a safeguard is easily achieved. Heavy expenditure in elaborate fittings is unnecessary; lamps of high wattage are also not required. The desired result is simply a matter of careful study of the conditions of service and the application of suitable REVO "Magnalite" fittings.

Every requirement is catered for by REVO "Magnalites"; there are thousands in use making miles of streets safer by night. Let them lessen the danger of your streets after dark.

REVO

ELECTRIC STREET

LIGHTING EQUIPMENT

Made by REVO ELECTRIC Co., Ltd., TIPTON, Staffs.

Counting by Means of Light

In our last issue we illustrated the "Raycraft projector," which enables operations to be controlled by means of light. The adjacent diagram, furnished by Radiovisor Parent, Ltd., shows the essential parts of the mechanism involved in an automatic counting apparatus. The diagram is self-explanatory. When any object comes in the path of the light rays there is a momentary interruption of the light, and hence, also, of the current produced by the light sensitive bridge, which operates a relay. In general, the counting apparatus only responds to sudden changes, and can therefore be used in daylight. For the same reason (unless special provision is made) it will not count objects moving very slowly! In its standard form, however, it can be readily applied to many factory processes, such as those involving the passage of articles or cases down a conveyor.

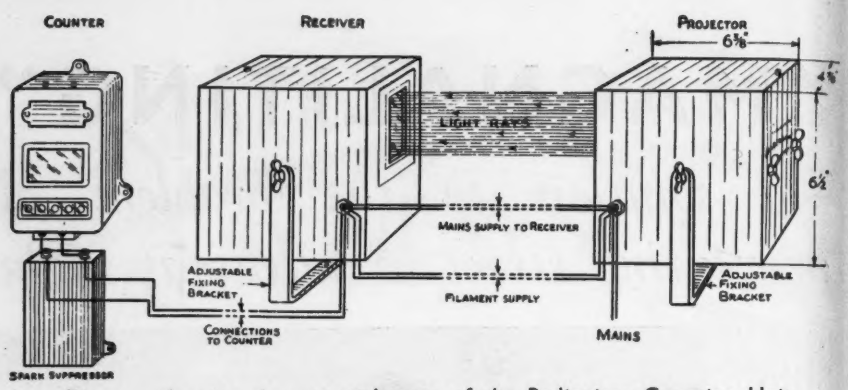
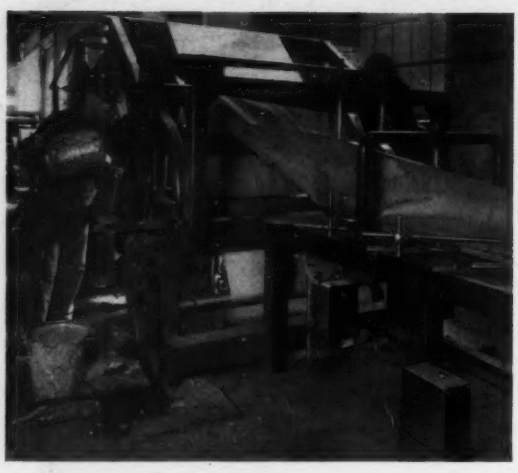


Diagram showing the essential parts of the Radiovisor Counting Unit.



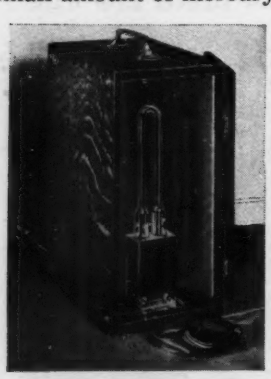
We are indebted to the British Thomson-Houston Co., Ltd., for particulars of their photo-electric relays which are actuated by a beam of light and have applications similar to those mentioned above. The particular illustration here shown relates to a paper-bag making machine. This is equipped with a photo-electric relay, two external photo-electric cell holders, and a projector lamp for controlling the sidelay of paper.

Laboratory Lamp with Incandescent Cathode Burner.

New Types of Mercury Lamps

We illustrate here two examples of the new mercury discharge lamps, viz., the Vi-Tan ultra-violet unit, and another type incorporating an incandescent cathode mercury discharge burner, which were exhibited at the meeting of the Illuminating Engineering Society on January 14. These units represent the latest developments in this field made by the Thermal Syndicate, Ltd., who are well known as manufacturers of fused quartz (Vitreosil), which is used in their construction, and who have supplied mercury vapour burners to the trade for over twenty-five years.

The new lamps have the advantage that only a small amount of mercury is used. They are of robust construction, transportable, and can be used in any position. Furthermore, they start on the switch, whereas the older types of lamps either required careful tilting in order to start them or were operated by special auxiliary starting-gear.



The Vi-Tan Unit.

The Vi-Tan unit is a compact, portable unit, neatly housed, complete with flexible connection and goggles, in a polished oak cabinet rather smaller than an ordinary radio set. It is economical to run, requiring no heavy starting current, and consuming only 50 watts. It is stated that 99 per cent. of the radiation is in the true ultra-violet region (below 3200A°), and although designed, as already mentioned, primarily for home use, it is a convenient source of U.V. for many other purposes. It operates directly from 200-260v. A.C. mains.

The Incandescent Cathode Discharge Burner unit shown operates on 200-250v. (mains) at 2.15 amps. through appropriate auxiliary equipment for A.C. or D.C., as desired, and the light emitted has spectral distribution similar to the older mercury arc lamps. This particular unit has been designed in a convenient and portable form for laboratory use, especially for routine testing and for research and experimental work requiring ultra-violet light.

These mercury burners have envelopes of fused quartz (Vitreosil) which allows the maximum transmission of ultra-violet light of any manufactured material down to 1850A°. The makers can provide spectrum analyses of all these burners, which enable users to choose a burner suitable for their special requirements.

The General Assembly Shop; one of many departments in the extensive factories of Benjamin Electric, Ltd., at Tottenham.

A Section of the Machine Shop with Tool Making Department in the background.

Benjamin Electric, Ltd.

A Remarkable Record of Progress.

IN the course of a recent visit of the Press to the works of the Benjamin Electric, Ltd., at Tottenham, some interesting particulars of the growth of the business were given. The company was established in 1908 in Rosebery-avenue, London, E.C.1, for the manufacture of scientific lighting equipment.

In 1918 the demand for space led to removal to larger premises at Tottenham. In 1925 a further six manufacturing bays were added to the new factory. By 1927 business had expanded so greatly that it became necessary to build another factory, doubling the floor space previously held. Since then, however, the floor space has been nearly quadrupled. The original Benjamin Factory, together with the 1927 extensions, is now used purely for "complementary work" to the main production which is undertaken in the new Factory No. 2, on the opposite side of Tariff-road. Here all the main mechanical manufacturing operations are carried out, and the main Benjamin products, Lighting, Radio, Water Heater, and Automobile, are produced in what is a veritable hive of industry.

A few of the various departments are illustrated here, but there are many others. All tools used in the production of Benjamin products are made by the firm's own toolmakers in their own shops, and likewise the innumerable stampings, pressings, etc., required. Of special interest are the heavy presses by which the well-known "one-piece" reflectors and other special stampings are produced. The unique nature of this work is well illustrated in the process of shaping from one piece a 20-in. diameter reflector shape 17-in. deep—involving seventeen separate operations. Other important sections are those dealing with vitreous enamelling.

The Engineering and Lighting Engineering Service Department should not be overlooked. Here planning and routine testing are carried out, and there is a well-equipped photometric laboratory. The integrating photometer, made by one of the staff, is stated to be one of the largest in Europe. The study of the applications of the firm's equipment and the preparation of data of service to users is an important element. As may be imagined, too, the Publicity and Sales Development section has a somewhat formidable task in keeping abreast of the manufacturing capacity of these vast factories. A special feature is the preparation and dissemination of the "Light Literature," skilfully compiled in this department, including the familiar house organ, the "Reflector," which is very widely circulated.

Changes in the lighting industry—which is truly in a state of constant flux—in themselves impose the necessity for alertness in production. The introduction of the electric discharge lamp, for example, has profoundly influenced methods and design. Benjamin Electric, Ltd., have recently produced a complete range of reflector equipment for use with these new lamps.

Here the "Magnavox" Loudspeakers are assembled. Note the special local lighting by Benjamin Miniature Intersolux in the foreground.

The Publicity and Sales Development Department—a very necessary one, in view of the vast production capacity of these factories.

LIGHT AND LIGHTING

Back Numbers.

Readers are reminded that back copies of this journal, (which until this year appeared under the title of "The Illuminating Engineer") are still available. Lists of individual copies dealing with special subjects will be supplied on demand. Complete sets of twelve issues (unbound with index) can be supplied for 1934 or 1935 at 12/6 for the series, and for the years 1928-1933 at 15/- per series. Special Binding Cases, 4/- each.

I.E.S. TRANSACTIONS

Loose Leaf Covers.

The Transactions of the Illuminating Engineering Society, containing the full text of papers and discussions, are issued free to all members of the Society, who also receive Loose Leaf Holders on request.

It has now been decided that the subscription for others who desire to receive the Transactions will be 15/- per annum. The cost of Loose Leaf Covers for holding the Transactions is 3/6 (post free).

UP-TO-DATE WITH GAS

Corporation Street, Birmingham, under the new system of Gas Lighting.

New Street, Birmingham, under the new system of Gas Lighting.

means A1 light for Birmingham

When Birmingham resolved to provide conditions of illumination corresponding to "Class A" of the British Standard Specification they chose high pressure gas lamps suspended over the carriageway by wire cables spanning the street and attached to buildings on each side.

The respective widths of the carriageways in New Street and Corporation Street are 35 ft. and 40 ft. Pairs of lamps, each yielding about 3,000 c.p., are mounted 7 ft. apart, and spaced at intervals of 70 ft. The height of the lamps above the surface of the roadway is 26 ft. 6 in.

Please write for a copy of our street lighting booklet "To every public man and woman" — it's free — to the address below.

THE BRITISH COMMERCIAL GAS ASSOCIATION, *28, Grosvenor Gardens, London, S.W.1.*

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